AUTUMN 1991 The Magazine of the Commission for the Future $9.95

21C

PREVIEWS OF A CHANGING WORLD

Will The Future Be Ethical?

PETER SINGER, PHILOSOPHER, TALKS TO TERRY LANE

Your City of the Next Century

... and What You'll Eat

God and Science: The New Relationship

ABC Quantum

WHY WAIT?

You hear new music 1st on

TRIPLE J

ADELAIDE	BRISBANE	CANBERRA	DARWIN	HOBART	MELBOURNE	NEWCASTLE	PERTH	SYDNEY
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Welcome back to the Future

THIS ISSUE OF 21 C represents a large step into the future. After a strong response to our first issue, the Commission for the Future has decided to present its vision, through the pages of 21 C, even more boldly.

This issue provides several glimpses of that future. In Australia, it is a future of big cities [*page 6*] with even bigger problems waiting for solutions: too many roads, too many cars, too many large houses, too much pollution.

Equally pragmatic is the issue of what we will be eating in our cities of the future [*page 66*]. Restaurateur Stephanie Alexander paints a glowing picture for those committed to eating natural food, while Alan Saunders and Cherry Ripe open the cupboards of the 21st century to find artificiality, additives and food-substitutes.

From earthly urban dilemmas we turn to the fascinating relationship between God and Science [*page 14*]. As Margaret Wertheim so tantalisingly puts it: "One of the reasons why physics has become so appealing to a wider public is precisely because its theories are now giving us a picture of a universe that apparently has the stamp of a higher creative power on it."

And we take you into the inner sanctum of America's space planners to examine the programme that is taking mankind towards life in space [*page 50*].

SUSAN OLIVER

There are also several new components of 21 C unveiled with this issue. They include a regular interview conducted by arguably Australia's finest interviewer, Terry Lane [*page 42*]. It launches with an extensive interrogation of the eminent Australian philosopher Peter Singer, who grapples with one of the most vexing questions facing anyone concerned with the next century: Will the future be ethical?

TERRY LANE MEETS PETER SINGER

We also launch Lifespan [*page 35*], a new segment which unravels the lifespan of everyday items — in this case the telephone — and attempts to plot their future shape.

And we have greatly expanded the NEXT section of the magazine into a self-contained 16-page package of news and information about trends, new products, research, people and ideas. NEXT [*page 19*] appropriately is printed on recycled paper.

This issue of 21 C touches many of the issues that go to the heart of what the Commission for the Future is all about. Many people support the CFF as a "good thing" — exactly what type of "good thing" is harder to pin down. I think people are vaguely reassured that there is a watchdog organisation for the future, perhaps because the future can sometimes feel to be so much out of our control.

But if the future is unknowable, the goals of the CFF are quite tangible. The Commission aims to inform key decisions being made now which will shape our future. The Commission is a commission for future strategies, planning desirable futures and plotting an implementation pathway to get there.

ALL THE NEWS IN NEXT

Over the years of its operation, the Commission has established informal networks throughout the world, including research groups, sister futures organisations and individuals practising in the futures area. Many of these people are exploring new knowledge and challenging some of the old ways. One of our high priorities is to formalise these networks, creating strategic alliances to give us skills where we don't have them, and to offer our skills to supplement theirs. We intend to be involved in international joint projects, particularly in our own Asia-Pacific region.

My 11-year-old son says that the Commission should shape the future and make it a better one. It sounds simplistic, I know, but as a *raison d'etre* it makes a great deal of sense.

SUSAN OLIVER
Director of the Commission for the Future

21 C

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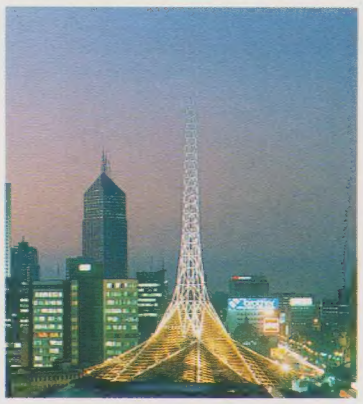


METROPOLIS

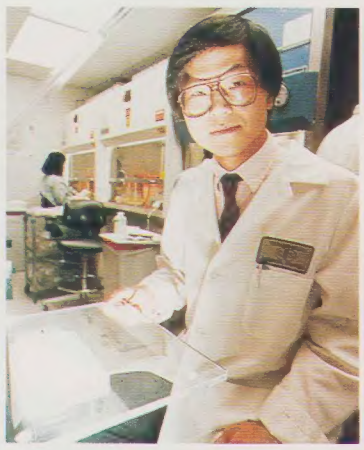
Will the Australian city of the future be sustainable or just more cars, more roads and big homes? As the urban sprawl continues ever outwards, hope for sensible 21st century cities housing several million people is looking more and more like an impossible Australian dream.

PAGE 6

GOD AND SCIENCE

TOE is the Theory Of Everything. It is attempting to explain a nexus between two of the greatest forces in the universe – God and science. If it does, the world as we know it may never be the same again.

PAGE 14



DATAMATE '98

Wendy Harmer gets ready for her Perfect Match, only seven years away.

PAGE 56

250,000 A DAY

That's how many babies are born into the world – and it's too many.

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DINNERTIME 2000

What will our food be like in the 21st century: a menu is on its way.

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AIDS – THE BREAKTHROUGH?

Finally, optimism is creeping across the ever-gloomy AIDS landscape.

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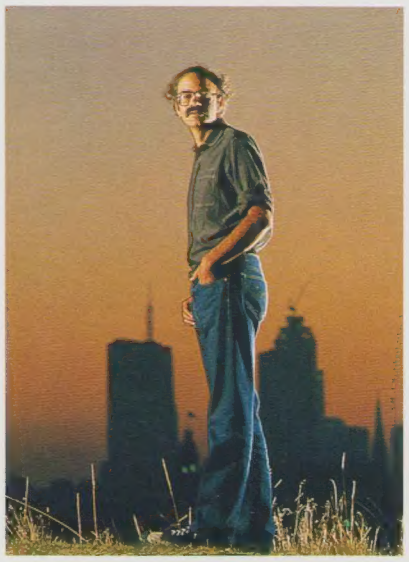

LIFESPAN

Alexander Graham Bell could never have imagined the way his invention now rules the world – or could he?

PAGE 35

THE PHILOSOPHER AND THE FUTURE

Ask Peter Singer about the morality of human treatment of animals, and he is convincingly unambiguous. Ask him – as Terry Lane does in this interview – about the likely ethics of the next century, and he isn't quite so sure.

PAGE 42

LIVING IN SPACE

The US space programme is edging towards the day when humans will live satisfactorily on another planet. But a day in the life of space still sounds uncomfortable.

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KAZ COOKE

In the future, the biggest breakthroughs may be the simple things in life.

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ON THE ROCKS

Antarctica faces multifarious challenges to survive intact into the next century.

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OUR DYING BIRDS

The future for Australia's birdlife is far from happy.

PAGE 92

THE GULF WAR AUDIT

The outcome of the Gulf War affects the future in many ways, few of them positively.

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NEXT

16 pages of news, trends, products and research.

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COLUMNS

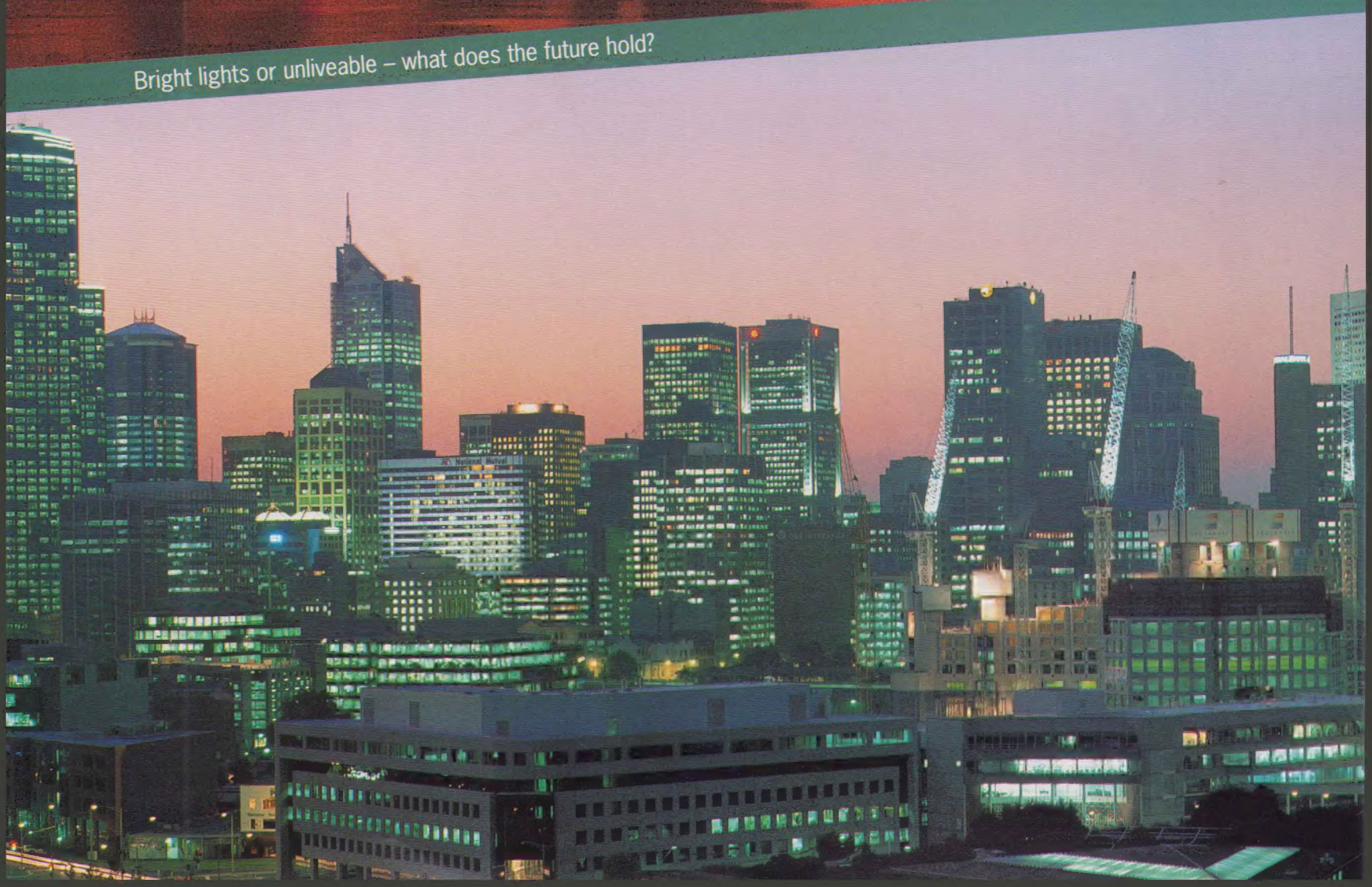
CORPORATE VISIONS

OUR WRITERS

Inside back cover

METRO

Bright lights or unliveable – what does the future hold?



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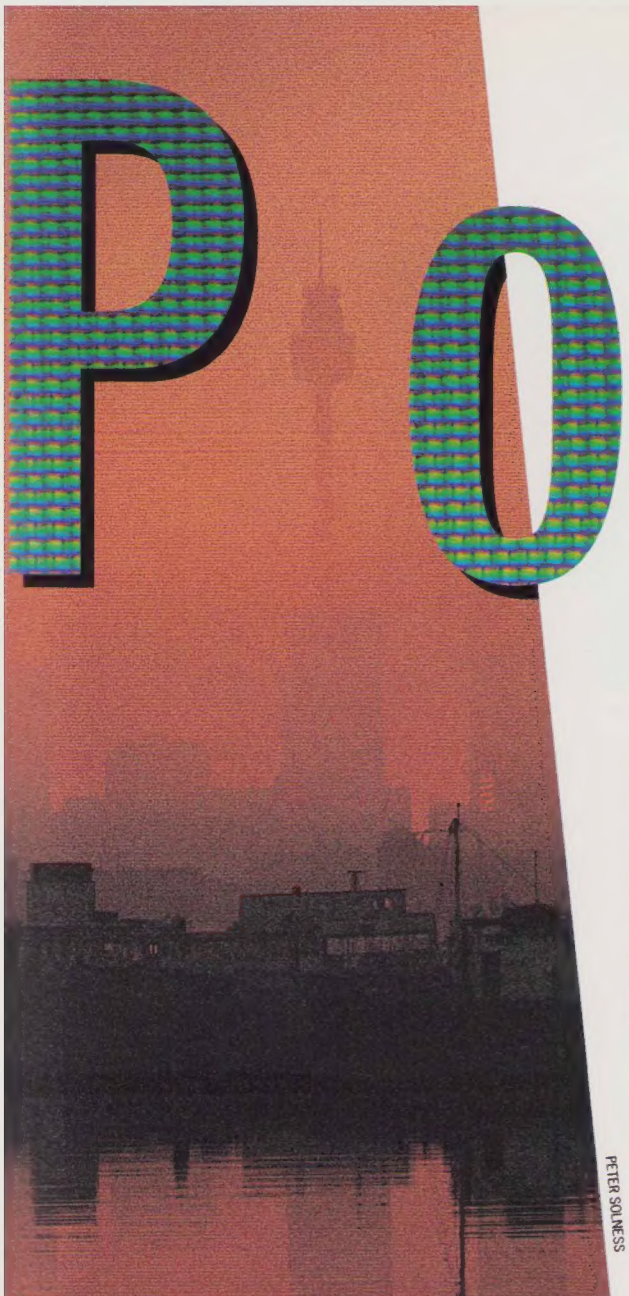


PETER SOLNESS

ROBERT BANKS/IMPRESSIONS

As a highly urbanised nation, Australia's future is inextricably linked with the fate of its big cities. But will they continue to be sprawling urban playgrounds full of more cars, more pollution and too many greenhouse gasses?

BY KATHY KIZILOS AND KEVIN O'CONNOR

PHILLIP Toyne, the president of the Australian Conservation Foundation, has a vision of the metropolis of the future. It is a collection of discrete, energy-efficient villages, fed individually and powered by the sun and wind. A place where bicycles and light rail are used for transport. Where workers "telecommute" using home computers to communicate with the workplace. And where freeways are ugly relics of a past age.

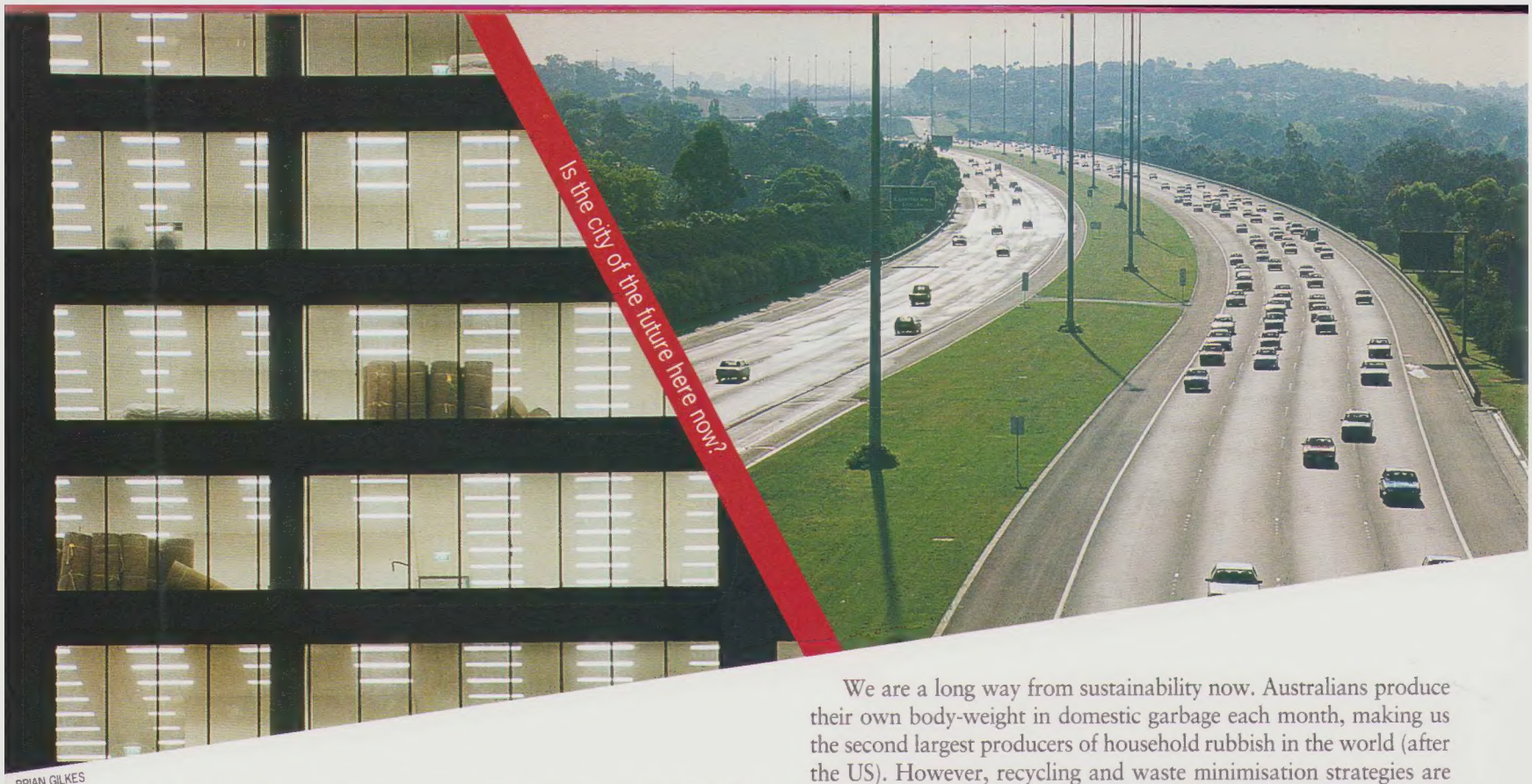
It is, sadly, a utopian vision far removed from the real world of Australia. A world in which the car is king – in which 85 per cent of all private trips by Melburnians are made by car and in which 65 per cent of Sydneysiders drive to work. A world where suburbs on the city fringes – the suburbs that will absorb the bulk of the future population growth – are sometimes more than 50 km from the central business district.

And a world of potentially unsustainable cities which use too much energy, produce too much waste and sprawl too far into the countryside, devouring bushland and good agricultural soil. In fact, Australia's two largest cities use more than double the transport fuel of European cities, produce two to three times the greenhouse gases, and sprawl more than four times as far into the countryside.

Nor is it a world which shows any discernable signs of changing direction. The 1988 Metropolitan Strategy for the Sydney region, for example, includes plans to upgrade the arterial road system because, it asserts, good roads are central to Sydney's economy; even though noise pollution is already a problem for residents.

In Melbourne, meanwhile, the city's size will have swollen by about one million dwellings by 2030, needing 70 per cent more land for residences. And in Sydney planners expect the population of the metropolitan area to grow to 4.78 million by the year 2006 – yet the 1988 metropolitan strategy was designed to accommodate a Sydney region population of 4.5 million people.

POPULATION: Fuelled by our immigration programme, population growth drives most Australian planning decisions. Although accurate predictions are impossible, over the next four decades the population of Melbourne is likely to grow by more than the current population of metropolitan Brisbane and Adelaide. Over the next 15 years, the population of Melbourne will have increased by 500,000 people – twice the population of Canberra. Most of these people will be accommodated on the under-serviced urban fringes.



BRIAN GILKES

Exactly where Sydney can accommodate more than 4.5 million people has yet to be finally determined by its civic planners. Land audits have been taken around Wyong, 110 km to the north, in the Hawkesbury-Nepean basin, and in the southern tablelands. How to develop these areas without further fouling the river systems is still unresolved.

Environmentalists are already alarmed at the pollution levels in the Hawkesbury River. According to CHANGE (Coalition of Hawkesbury and Nepean Groups for the Environment), the Hawkesbury will be biologically dead within five years. Effluent from more than 40 sewage treatment plants already flows into the Hawkesbury, the river that supplies Sydney's drinking water.

HOUSEHOLD SIZE: Population growth is not the only factor contributing to the ballooning of our cities. Throughout Australia household size is also decreasing. For example, the population of inner Melbourne has fallen by 146,000 (or by about 40 per cent) since it reached its peak in 1947.

And the downward trend is not confined to the gentrifying centre. Virtually every Melbourne suburb built before 1970 is losing population. Families are splitting up and more people are living alone, so that even if the population of the city remained static more houses would be needed.

DENSITY: Throughout history, cities have commonly housed between 100 and 200 people per hectare. In Australia, a penchant for privacy and space is fast producing social, environmental and financial trouble – a penchant for sunrooms, studies, television rooms, rumpus rooms and two bathrooms, which have been unknown to most people in the past and continue to be out of reach to most people today.

The concept of dual occupancy on our large house blocks is now being promoted in Melbourne and Sydney. It is part of "urban consolidation" policies which seek to encourage the building of medium density housing (walk-up flats) in new and established areas, and smaller lot sizes on the fringes.

THE ENVIRONMENT: The buzz-word is "sustainable". We want sustainable cities with sustainable industries, transport and garbage collection systems. But there is no agreement yet as to what the term "sustainable city" means, or how it can be achieved.

The idea of the sustainable city grew out of the environmental movement. In general it means a city that is ecologically sound – one that isn't profligate with its resources, that recycles, and that accommodates growth while having a minimal impact on the environment.

But the sustainable city has also come to mean the ideologically sound city – one which provides adequate services and employment to all classes and which reduces urban isolation and alienation.

We are a long way from sustainability now. Australians produce their own body-weight in domestic garbage each month, making us the second largest producers of household rubbish in the world (after the US). However, recycling and waste minimisation strategies are at last catching on. In Victoria, the Environment Protection Authority has set a target of reducing domestic waste by 50 per cent within five years.

And technology is providing some answers. In Melbourne's eastern suburbs a privately owned landfill has recently opened which will use methane, a by-product of organic waste, to generate electricity which will be fed into the state's power grid. The owners, the American company Browning Ferris Industries, are also planting thousands of native trees on the site and will return the land to the council for recreation when the quarry fills.

Environmentally, Victoria is in a better position than NSW, having the strictest air quality controls in Australia, a good sewerage system and city beaches that are still "swimmable". The 1990 City of Melbourne Strategy Plan described "vehicular traffic, air pollution and congestion generated from excessive car use" as "perhaps the most intractable problem confronting (Melbourne)".

TRANSPORT: Both the NSW and Victorian state governments say they are committed to improving their public transport systems. But unless housing densities increase dramatically, and unless infrastructure funding rises soon, effective and economically viable public transport will remain, like the next bus, in the realms of possibility.

In NSW, land releases increasingly take place in suburbs with good access to public transport and new land has been purchased for public transport corridors. In both Melbourne and Sydney new suburbs are being planned more carefully – attempts are being made to co–ordinate the location of shopping centres, houses and government and public sector office space with public transport routes.

Technology may provide a partial solution through "rapid trains". Regional centres may develop as "dormitory suburbs" in which people commute by fast train to the centre. "Telecommuting" is a rising trend in the US, where 7.5 million people are expected to telecommute by the year 2005. But this could also have the negative effect of increasing the isolation now so characteristic of suburban life.

ECONOMIC DEVELOPMENT: Long-term vision is necessary in the creation of new industries. Planners report that education and tertiary industries are likely to be growth areas, as are health, sporting, cultural and artistic services. Sydney is already attracting more head offices of corporations than Melbourne, and financial and business services are likely to grow; these industries may decline in Melbourne if this trend continues.

In the other growth areas of tourism and community services there is a danger that the gap between the privileged and the battler could widen further, with the well-paid living in well-serviced urban areas and the rest having to make do in isolated or degraded pockets of the city.

INFRASTRUCTURE: More money is needed, not only for ongoing capital works on the fringes of our two largest cities, but also for essential major projects such as improved rail links and sewerage plants.

NSW and Victoria are co-ordinating the provision of infrastructure with new developments to cut the duplication of services and to make sure residents in new outer suburbs are not waiting for years for a school and a bus.

Melbourne and Sydney carry the somewhat awesome responsibility of accommodating the halting steps of Australia's restructuring. Our metropolitan structure is copied from the British model, reinterpreted after contact with the US, which encouraged car ownership and local travel at rates that are high by world standards.

How can cities built with 19th century infrastructure accommodate the values and the opportunities of the 21st century? Locating new jobs at major rail and bus stations is a step towards resolving this situation, but planning schemes, which underpin present patterns in the location of jobs and housing, but hinder the emergence of new and different activities, have been slow to move towards this change.

THE FUTURE: The 1988 Metropolitan Strategy for the Sydney region gave two possible options for the city's development up to the year 2006: the "concentrated alternative" and the "dispersed alternative".

The two key features of the "concentrated alternative" are encouraging higher housing densities and promoting strong commercial centres throughout the Sydney region. The policy is meant to encourage a more equitable distribution of employment and better access to work (30 per cent of jobs are expected to be in major centres on public transport routes).

The plan calls for 9,000 multi-unit dwellings to be built each year, two–thirds of which are to be constructed in established areas. Densities will be increased in new areas, rising from eight lots per hectare to 10 lots, forcing medium density construction on the fringes.

In a recent discussion paper, the Victorian Ministry for Planning and Urban Growth outlined four options for that state's development up to the year 2030. Ideas from all four options may be used in a yet-to-be developed composite option. The options are:

- **Compact Melbourne.** Similar to Sydney's "concentrated alternative", this option will be the cheapest to implement and is therefore considered the most likely. Under this plan, Melbourne would continue to attract 70 per cent of the state's population growth but would encourage higher densities in both old and new areas.
- **Twin Cities.** Establishing a second major city focus (like Sydney's Parramatta) either at Dandenong in the south-east, which is already well-established, or in the north-east near Melbourne's airport.
- **New Towns.** Establishing three new towns of 100,000-300,000 people on the metropolitan fringes. The new centres would be largely self-contained and would be characterised by innovative design and environmental awareness.
- **Centres.** Projected population growth would largely be diverted to six Victorian country towns – Bendigo, Ballarat, Geelong, Shepparton, Wodonga and the La Trobe Valley. More jobs and amenities would flow from the growth – universities, hospitals and arts centres. It is hoped that economic development strategies would promote growth from "within" the centres rather than simply transplanting city businesses. The centres would be serviced by new communication and transportation systems. Melbourne would be freed from its worsening congestion and pollution, while retaining its national and international role.

SUSTAINABILITY

Can Melbourne and Sydney become more sustainable? Is it possible to simultaneously improve their environment and their economic performance – and make them better places to live?

A glimpse of what that future could be can be gained by looking at some of the best features of other international cities. Three trends which could improve the future would be to introduce light rail, traffic calming and urban villages, all of which are interrelated. Together they can give us some directions for more sustainable cities.

LIGHT RAIL: More than 330 cities around the world have joined the light rail revolution. Started in France and Germany, light rail combines the speed and comfort of a traditional train with the flexibility and pedestrian friendliness of the traditional street car or tram – plus all the hi-tech electronics and modern materials that can solve many of today's urban transport problems. Considerably cheaper to build than large scale highways, twenty-first century light rail has some special features:

- **Ground level access making it easy for all people.**
- **Comfortable seats and spaces for bikes and prams.**
- **Easy movement through cities to suburbs.**
- **Fast access along permanent-way areas.**
- **Electric power (renewable energy).**

TRAFFIC CALMING: Traffic is a problem everywhere. The more cities try to ease the problems with diversions or extra lanes, the more the traffic builds up and gradually our cities get engulfed by cars.

Some cities have begun to turn this around by traffic calming, giving more priority to pedestrians and cyclists by:

- **Heavy landscaping, especially at the entrance to streets.**
- **Widened footpaths and bikepaths.**
- **Special lips on corners that reduce the pedestrian crossing area.**
- **Angle parking and special road surfaces.**

Traffic calming is most effective when applied to a whole urban region and is designed to fit in with upgraded public transport.

URBAN VILLAGES: Generally in Australia we live too far apart to enjoy many of the advantages appreciated by European cities, such as really good public transport. We can change this building urban villages where there is little need for a car.

Usually built around a rail link, they are fully pedestrianised areas with parking only on the sides or in underground parking areas. They feature:

- **Extensive landscaping on streets, balconies and on buildings.**
- **Public places and community areas.**
- **High density housing with large internal spaces for families.**
- **Mixed land use with shops, offices and small scale agriculture.**

In the urban village most destinations are just a short walk away and others are reached through the train service. The whole environment of the village is attractive and facilitates the kind of communities we need in our cities. As more are built the city becomes less car dependent. Can you imagine an urban village being built in your suburb next to a rail station or around a light rail line?

PETER NEWMAN

SYDNEY, YOU'RE STANDING ON IT

CITY OF THE FUTURE

It is known as geotecture. It means creating underground cities - and it sounds far-fetched. But it could be the solution to the business-district congestion of a city like Sydney

BY SYDNEY BAGGS

IMAGINE you are standing on any bustling street in the business district of Sydney. Look down. Although you can't see it, there is another potential city lurking under your feet.

The area where this city could be built is the immediate 200-450 metres of space beneath your shoes – a subterranean zone that offers planners and developers the ideal space to build residential, industrial and commercial accommodation. A zone known as "geospace" in which it is possible to manipulate the combined thermal characteristics of the strata beneath and the atmosphere above with comparatively low energy inputs, to create a climate comparable with that inside above-ground buildings.

It may sound far-fetched, but the city district of Sydney could be redeveloped into a low-rise garden city; its industrial zones could be relocated into sub-surface space along corridors that "recycle" surface land for residential and recreational purposes.

What we are talking about here is geotecture. It involves the use of terratecture (cut-construct-cover) and lithotecture (tunnelling) technologies. And it requires the relocation of utilities, transit systems and waste treatment plants into conduits within these corridors.

Sydney is a city waiting for this kind of solution. Its urban surface space is becoming congested and its residual open space is overshadowed by high-rise development. The use of the sub-surface domain is an alternative planning option that would not only be energy efficient, but also efficient in its recycling of industrial land for residential, commercial and recreational purposes.

It is a concept that challenges traditional city growth patterns. It would require a dramatic decision: to allow the present ground surface development to finish its life-cycle, and then re-think the "high-rise" formula of the past – while still preserving historically significant structures and recycling the land surface to recreation and parkland.

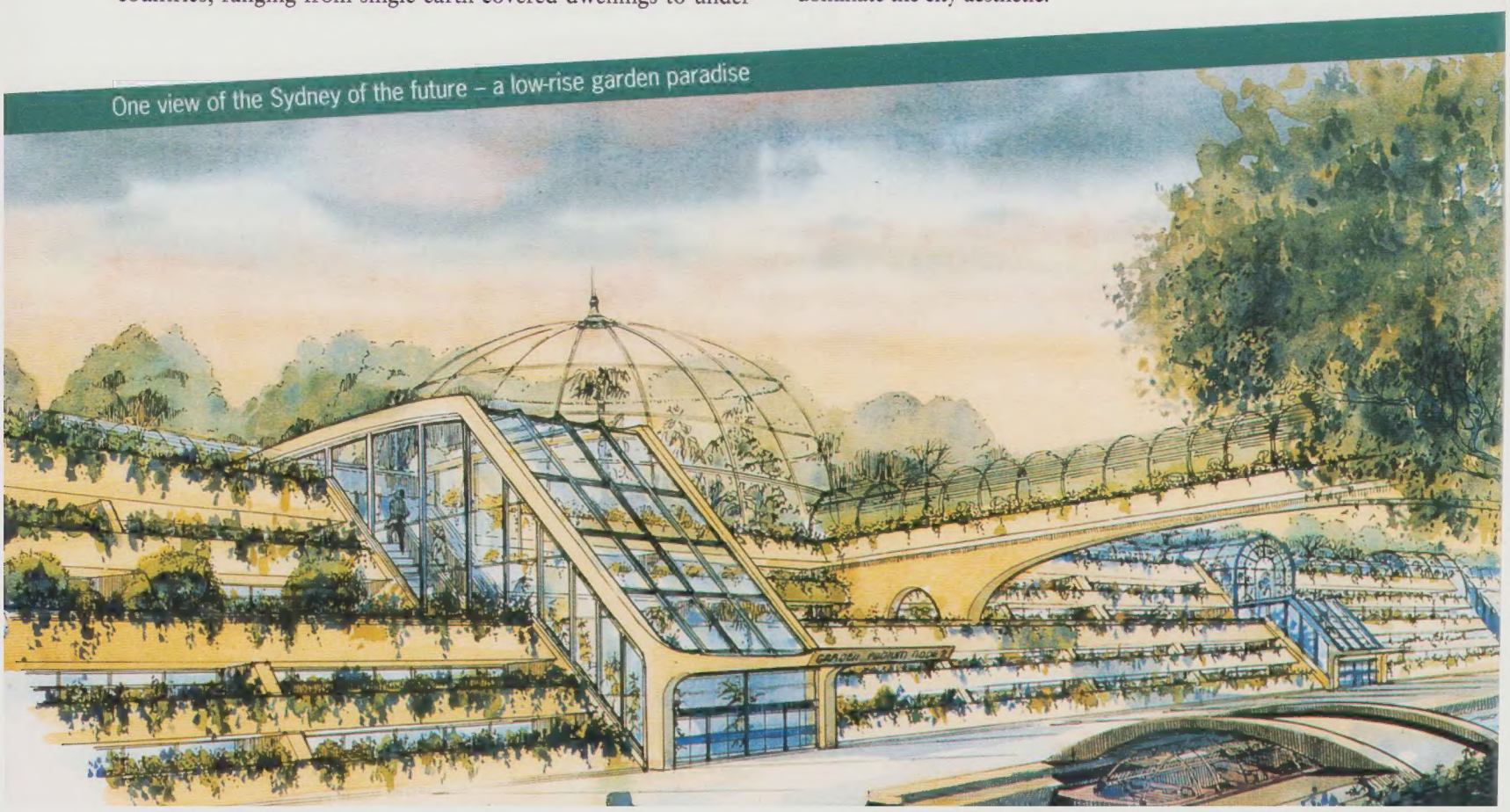
In fact, examples of modern geotecture can be found in numerous countries, ranging from single earth-covered dwellings to underground shopping centres and industrial complexes. In Soviet cities, for example, 35 per cent of all building costs are spent on underground structures. In Montreal, Canada, harsh winters make underground shopping logical; in Los Angeles, cool shopping is possible in a vast complex beneath the Arco building. There is a shopping centre linked to the subway development in Seoul, South Korea; in France, the Metro development of Paris is world famous, as are the UNESCO recessed-atria buildings and the new extensions to the Louvre with their glassed-skylight atrium. Extensive underground developments exist in Sweden, Japan and Norway, incorporating underground transport, sports centres, swimming pools, hospitals, theatres and bulk storage facilities for liquids, gases and solids.

The idea of geospace utilisation is not new; its history is ancient. From the Orkney's, 2,500 years ago, we have a legacy of an earth sheltered village – whale bone and turf roofed, exposed by a storm at the beginning of this century.

In Cappadoccia in central Turkey, from the Paleolthic to the present, underground towns and cities reached their peak occupation in early Christian times. Excavated into the soft tuff rock, they provided security and comfort in the cold winters and hot summers. Today, more than 200 million Chinese live in this manner.

Contemporary geotecture was given new life by the oil crisis of the 1970s, which forced planners and architects to find alternative ways to create more energy-efficient urban structures. In Australia the move under ground, although hardly spectacular, has started to occur due to the need to conserve energy and the desire to preserve the natural beauty of sites. There are a number of examples: earth-covered houses, churches, a kindergarten, a school and an aboriginal art museum have all been constructed in regional NSW. In Sydney itself, many city developments incorporate significant proportions of geotecture in basements and pedestrian networks. But there is an overall lack of integration and optimal space utilisation, and no real understanding of the exciting possibilities of considering city development in a radical fashion.

Of course there is very little legislation or planning regulation to facilitate such a drastic concept. Sydney's current city-planning proposals do not address the prospect of integrating both buildings and open space. By attempting to unify the city with landscaping schemes that only deal with the spaces left over between buildings that presently funnel wind and overshadow streets, building volumes continue to dominate the city aesthetic.



One view of the Sydney of the future – a low-rise garden paradise

But why, one might ask, not question the validity of the assumption that buildings must be expressed in their current form? Why not create a roof-garden city which gives priority to the needs of pedestrians? Sufficiently elevated not to overshadow parks and streets below, this podium need be no higher than existing historic buildings. It would, however, be high enough to achieve the full 10:1 (plus) floorspace ratio prescribed by the planning strategy implemented in 1990. By city block amalgamation and the utilisation of a major proportion of geospace in total building volume, a new aesthetic for cities of the future becomes possible.

A geotecture strategy would also require an appropriate interdisciplinary planning body comprising planners, architects, civil, structural, mining, tunnelling and mineral engineers, geologists, sociologists, psychologists and real-estate consultants. And it would probably need a decade of forward planning.

With whole industrial zones relocated into corridors of sub-surface space built around sunlit atria – with all energy, waste, transport and water services integrated within conduits in the corridors – one 7km corridor could relocate all Sydney's existing industry in its zone and "recycle" the surface land for landscaped recreation and medium-density residential land use for 44,000 new dwellings.

As high-rise towers within the city central area reach the termination of their life cycles, whole blocks could be amalgamated and a 4-6 storey podium city developed with parks and gardens. With the recycling life of a typical city building being 35-50 years, Sydney could become a garden city before the middle of the next century, with rooftop parks linked by grassed bridges from one amalgamated city block to the next.

Nor is it difficult to imagine the technical realities. With waste heat recycled, compact earth-integrated energy-saving building design, waste treated within the underground conduit and residues recycled or pumped out through conduits to the western plains for agricultural use, the city of Sydney could become almost benign in its environmental impact. With non-polluting personal vehicles that utilise very fast pallet-aided transport and "smart" guidance and return-to-base controlled vehicles, suburbs can share in the stimulus of city life without overburdening city parking.

"High-rise" could become a bad memory. Appropriate lightweight structures such as the greenhouses of the Royal Botanic Gardens could identify the entrances and lobbies of shopping complexes or commercial sites located below the rooftop gardens. A unified building stratum (which still uses the prescribed floorspace ratios for commercial viability) would unify the whole city.

With Very Fast Train (VFT) links through underground conduits and tunnels in built-up areas, interstate and intrastate air travel could become a secondary option. Pallet-aided transport (PAT) could simplify the distribution and collection of containerised goods in other corridors within the geospace conduits.

It all sounds like such a fantastic prospect – but not an impossible one. There is, after all, a spirit of change in the air. Environmentalists are achieving political power and becoming the new generation of engineers, planners, economists, entrepreneurs, scientists, architects, landscape architects and bureaucrats: people who are likely to co-operate rather than compete in design and planning.

So look down at the city streets next time you're in Sydney, or indeed in any other large, congested, dark, cold, concrete, windy city. And think of what could lie under your feet.

PETER SOLNESS

GOODBYE TO THE QUARTER ACRE BLOCK

HOUSE OF THE FUTURE

Welcome to the Australian house of the future. It is smaller, crammed full of technology, built in pre-fabricated sections, constructed of much more plastic and situated on smaller blocks of land further away from the centre of big cities

BY BRUCE KINGSTON

THE HOUSE of the future is alive and well in present-day Japan. There, home buyers can walk into a showroom, design and order their pre-fabricated house and, a week later, move in.

In Australia, where old habits die hard, there are no pre-fabricated home showrooms or one-week houses – yet. But with new building products and ideas flowing like water, the instant technological house is ready to happen.

In fact, technology is less likely to affect the shape of the Australian home of the 21st century than social and environmental trends such as:

• Modern communications and transportation, which will see Australians less concerned about their commuting distance from work and much more interested in using rapidly evolving technology to advance their lifestyle.

• The importance of environmental issues, marshalled by groups like the green movement, which will continue to have a tremendous impact on how we live, work and play, which in turn will have a substantial effect on house and community design.

• The nature of our population – more older people, an increasingly multicultural component and a greater predominance of extended rather than nuclear families.

• The increasing emphasis on leisure time and recreational activities.

Australian housing will move away from the terrace and tract house styles of earlier this century, where small family units were accommodated close to factories or offices or in dormitory suburbs along main routes of commuter transport. Many local government groups have recognised these changes and have altered building codes to allow extra family accommodation on previously single dwelling allotments.

Current trends to smaller housing allotments and developments such as cluster housing in many of our cities are pointers to some of the attempts to solve the problems of limited space and high prices. According to the co-ordinator of the Royal Australian Institute of Architects (RAIA) Community Architecture Group, Carolyn Ozturk, the average size of housing lots could be reduced to 200–400 sq m, with housing filling the majority of the allotment and landscaped common areas being used for recreational purposes.

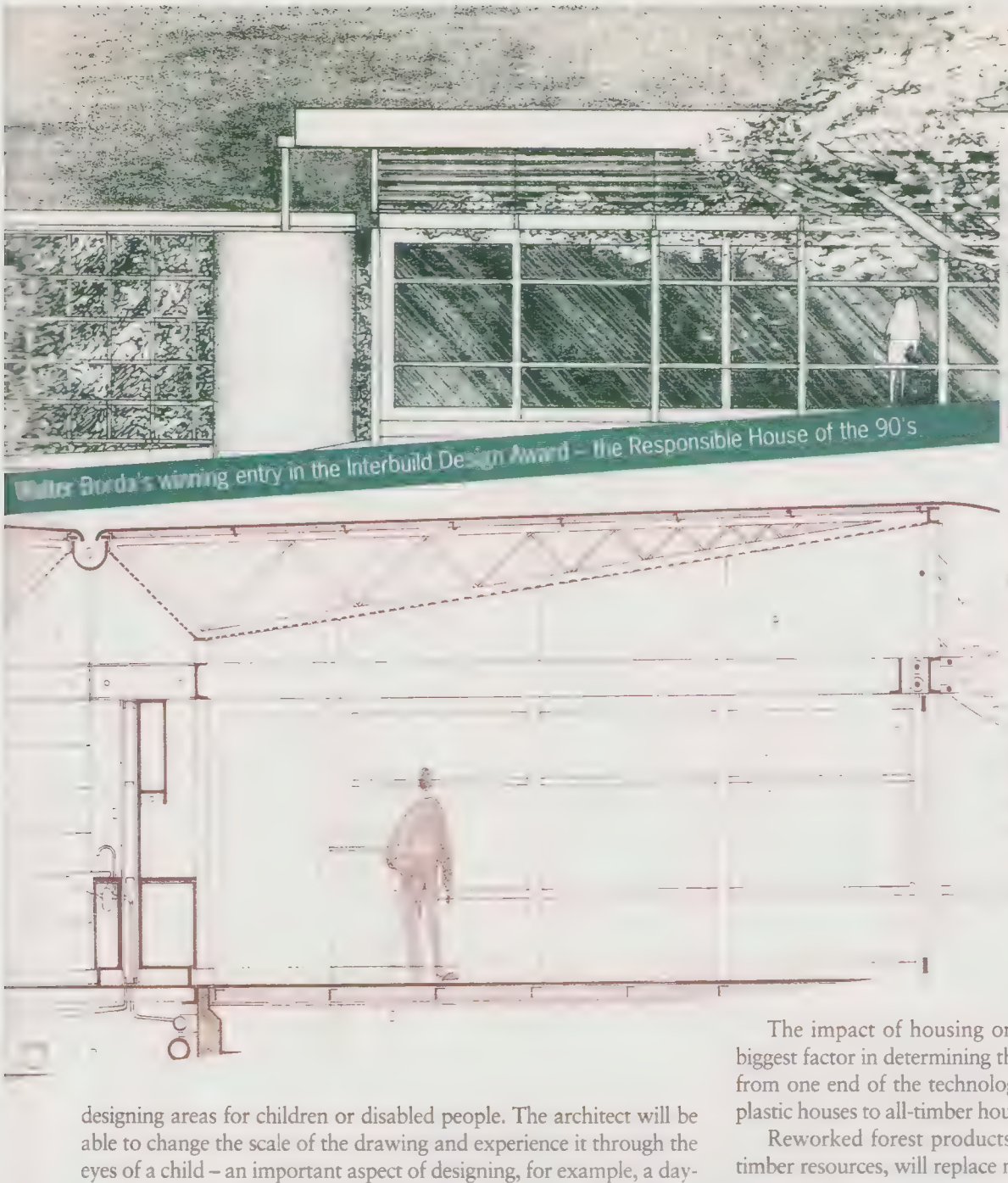
And after the excesses of the 1970s and 1980s, which were dominated by large-scale development, there is a trend towards a more humane environment and a greater sense of community. In these communities, home, work and school are seldom far apart. In Europe, many of these development styles are already clearly evident, with a return to a "village" style of life which still contains all the modern amenities that can now be provided.

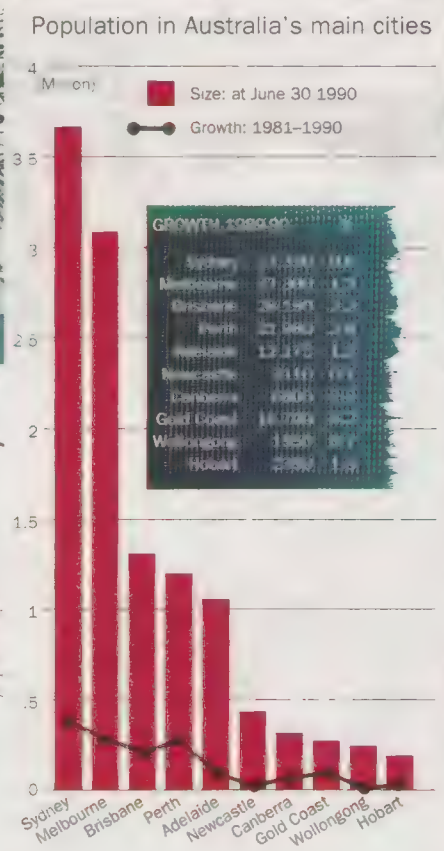
One of the features of small communities may be their relative independence from mainstream power supplies. Recent developments in Europe have seen communities drawing their heating and some power supplies from individual natural gas power plants. It is possible that the new villages may be virtually independent from the major coal and oil fired power stations, not only reducing the impact on the environment, but also freeing up some of the enormous capital invested in electricity distribution.

In addition, technological developments will help to make the average dwelling less reliant on electricity to heat and cool. The design process is also changing rapidly and activities which are currently still in the "gee whiz" category in computer design, such as cyberspace and virtual reality, will become standard features of the architect's tools of trade. Computer Aided Design (CAD) is already commonplace in more than half the architects' offices in Australia, and virtually every design professional in the year 2010 will have CAD facilities as an indispensable feature of their offices.

Virtual Reality imaging processes (or more probably some vastly improved version thereof) will allow the architects to show their clients through their new home while it is still on the drawing board, allowing the client to "walk" through the building and "see" the view through various windows and doors. The client will be able to judge colours, textures and finishes, and will be able to get an image of their prospective home as it will look in their urban streetscape, landscaping and all.

One of the most intriguing characteristics of this type of technology will be its capability to put the architect into the position of the end users.This will be particularly valuable when the architect is





designing areas for children or disabled people. The architect will be able to change the scale of the drawing and experience it through the eyes of a child – an important aspect of designing, for example, a day-care centre. Similarly, the architects will be able to simulate physical restraints and experience the problems of the elderly or handicapped in moving about in the newly created environment. In industrial situations it will be immensely valuable to have the ability to "walk through" the various processes to ensure that everything can be carried out in the space available.

One of the other hi-tech advances which will have distinct effects on the house of tomorrow will be the new and mooted methods of communication. Not only will this allow an enormous range of activities in the fields of image and data transmission, revolutionising current office procedures and computer applications, but it will also have the effect of removing the need for employees to physically attend at their traditional place of work. Here is the real impact on the future of the traditional house.

With the advent of fibre cabling systems with the broad capacity to carry interactive sound, data and video signals, the home office will quickly become a realistic option for many workers. Not only does the concept of "work from home" (even with significant up-front technology costs) appeal to many people tired of the commuting grind, but most companies spending mind-numbing amounts of money to house clerical staff in inner city office blocks would be only too pleased to have these same staff working from home, often in an environment which may be more conducive to a higher output.

Teleconferences and the hybrid faxes which link the fax machine to a laser printer and an interactive CAD/fax, question traditional office locations. With the development of wireless controls and transmissions for personal computers and peripherals, even more options open up. Far from developing impersonal "piece work ghettos" in the suburbs, the office workers of the future will have both options to be parents and to work, maintaining the best of both worlds.

The impact of housing on the global environment will be the biggest factor in determining the materials used to build houses – and from one end of the technology scale to the other, everything from plastic houses to all-timber houses may herald a new form of housing.

Reworked forest products, generally from waste or plantation timber resources, will replace many of the traditional timbers used in housing to create stronger, more aesthetically appealing structures. New products such as Scrimber, structural plywood and LVL (laminated veneer lumber) have offered structural timber products at competitive prices and have allowed a much broader quality of timber to be used and reduced the need to cut down our rarer and more slow-growing hardwood forests.

At the other end of the industry is the move to plastic or non-natural building products. The General Electric corporation in the US has paved the way for the future in plastic housing materials by building a house with a majority of plastic components. Dubbed the "living environments" house, it is an unashamedly futuristic house. It intelligently addresses many of the issues facing the home of the 21st century, incorporating energy management systems into the basic framework and including several options likely to be in general production over the next 10-20 years.

Developments such as plastic siding on houses may not be new, but complete plastic roofing panels, gutters, skylights, baths, doors, windows, walls, flooring and plumbing are fresh approaches to old problems. It also includes a number of uses for recycled materials, reducing potential criticism that a move to a plastic house would only serve to damage the environment through a further demand for a range of plastic products.

The development of prefabricated components – and even complete house sections – is on the horizon. With constantly rising labour costs and limitations imposed by weather conditions on site, more companies are manufacturing items such as bathrooms (with all plumbing and wiring already in place) which are simply delivered to the site and installed during construction.

In the quickly changing scene which will dominate in the next 20 years, the skills of the architect will be turned to more and more for solutions which will deliver cost effective housing that will stand the test of time.

GOD AND SCIENCE

Q: HOW COULD SOMETHING LIKE THE UNIVERSE HAVE BEEN SO MARVELLOUSLY CONSTRUCTED?

A: WE MIGHT BE ABOUT TO FIND OUT

Is the idea of God compatible with the ideas of science? A new movement in theoretical physics is trying to produce a mathematical description for an all-powerful force. Dubbed TOE – the Theory of Everything – it offers a scientific view of the universe that includes a spiritual dimension

By MARGARET WERTHEIM Illustrations by MICHAEL LEUNIG

ALBERT EINSTEIN once asserted that "God doesn't play dice" with the universe. Albert had rather definite ideas about just what the Lord did do with his creation, and perhaps no other mortal has come quite so close to seeing the mind of God.

For Einstein, discovering the principles which guide our universe was equivalent to being handed a part of the original cosmic blueprint. But although the laws of physics made him feel closer to the creator, for many people the two ideas are poles apart.

God and physics – why should these words clash so violently? Is the idea of a creator really so incompatible with a set of logically derived laws? And does the "new" physics offer anything to make the coupling less unlikely?

The rise of a scientific way of thinking in the west has coincided with a decline in the popularity of religion, since the two are usually considered to be incompatible. Finally we have reached a point where if you say you believe in both God and science you're likely to be accused of hypocrisy – or worse still, branded a woolly thinker.

In the land of logic, "woolliness" is the worst possible crime. Anything that cannot be supported by logical deduction from a reasonable set of premises is dismissed as humbug. Yet for many people, despite the great successes of science, there is still something missing. Three hundred years of astounding advances in physics have failed to give us an explanation of reality that satisfies the soul, as opposed to the mind.

That is, until recently. Go into any good bookstore and you'll find shelves of titles like *The Tao of Physics, God and the New Physics, The Cosmic Blueprint, The Left Hand of Creation, The Looking Glass Universe* and *Quantum Consciousness*. All deal with the spiritual and philosophical implications of new advances in science's most mathematical discipline.

Something, clearly, is happening. Someone has put the fizz back into physics. That awful subject which most people associate with activities like rolling ball bearings down inclined planes, or making little waves in a ripple tank, has suddenly started to sound interesting. Rumours abound of parallel universes, extra dimensions, black holes, white holes and worm holes, charmed quarks, and particles that can communicate instantaneously with each other from billions of miles away. Out in space and inside the atom amazing things are being discovered.

"We hope to explain the entire universe in a single, simple formula you can wear on your T-shirt."

Most intriguing and disturbing of all are the current ideas about reality itself. If new concepts in physics are correct, then there is ultimately no matter and and there are no forces. As physicist Paul Davies has put it, there is just "empty eleven-dimensional space-time curved into patterns . . . the world, it seems, can be built more or less out of structured nothingness." In other words, force, matter and indeed everything that "exists" are simply manifestations of space and time "dancing" with themselves.

Although it is true that the greatest scientific thinkers, including physicists like Einstein, Newton and Schroedinger, have always been interested in the philosophical implications of their work, physics has largely been a fairly prosaic business. Now it is trying to address the kinds of questions many people feel a deep need to ask. Questions like "How did the universe get here?", "When did it begin and will it ever end?", "What came before and what will come after?", "What is it made of?" and "What is reality?" And the answers physics is providing are appealing on many levels.

Although physics itself can say nothing about the presence or absence of a God or any other metaphysical entity, the new ideas are painting a picture of a cosmos in which such an entity may well feel at home.

The term "new physics" is rather an odd one since physicists are coming up with radically new ideas almost every year. Traditionally "the new physics" refers to Quantum Mechanics, the body of theories describing what happens in the sub-atomic world (inside the atom); today it refers to new ideas in cosmology, the field that looks at the universe as a whole.

So the new physics encompasses both the smallest things of all, and the biggest. One of the most exciting developments in recent years has been the realisation that in fact the two realms are interconnected – physicists now believe that an understanding of the smallest particles may hold clues to the nature of the whole universe.

Particle physicists probing the basic units of matter with "atom smashing" particle accelerators, and astronomers probing gigantic clusters of galaxies with telescopes, are all looking for the same thing: the physicists's version of the Holy Grail, the key to the Theory of Everything.

To get to the Theory of Everything first requires a quick summary of modern physics. There have been two great theories in physics this century. One is the General Theory of Relativity, the other is Quantum Mechanics. Relativity is basically a theory of gravity and it rules the vast realm of the stars and galaxies – and ultimately determines the shape of the universe. Quantum Mechanics tells us about how sub-atomic particles behave: protons, electrons, photons of light, and other more exotic things like neutrinos.

Much of the excitement about physics in recent years has centred on the efforts to unite the General Theory of Relativity and Quantum Mechanics. At last, it seems that we might be on the verge of finding one grand theory which will explain it all.

Physicists quite seriously call this the Theory of Everything. Leon Lederman, director of the National Accelerator Laboratory near Chicago, has described the search for the TOE, as it is fondly called, in a unique way: "We hope to explain the entire universe in a single, simple formula you can wear on your T-shirt."

One of the most important aspects of the TOE is that it could explain how the four fundamental forces in our universe are related to one another. The four are gravity (which makes apples fall out of trees and planets orbit suns, and is explained by the Theory of Relativity) and the three Quantum forces – the electromagnetic force (which is associated with electric charges and light), and the weak and strong nuclear forces (which hold the nuclei of atoms together).

Physicists now believe that all these forces are actually just different aspects of one all-powerful superforce. The search for this TOE has become the collective obsession of a large number of the finest minds of our time. Most physicists no longer question whether or not it actually exists; they simply argue about its properties.

An all-powerful force that rules everything and is explained by a miracle formula – perhaps I am mistaken, but that sounds not dissimilar to a mathematical version of you-know-who. It becomes even more so when you consider its role in our early universe. According to current theory, our universe was created in a state of perfect symmetry and at that time the superforce reigned supreme. But soon after the "Big Bang", the cataclysm which created space and time, the symmetry was broken and the one superforce was split asunder into the four forces we see today.

The idea of a world that was created in a state of idyllic perfection that was soon shattered is not a new one. What is new about this version is that it has an exquisitely elaborate mathematical basis.

One way in which physicists are trying to find their TOE is to extend the equations of general relativity to include the quantum forces and, in doing so, describe the universe by a complex multi-dimensional geometry. General relativity describes our universe as having four dimensions – three of space and one for time – but in order to account for all four forces current thinking is that 10 or 11 dimensions are necessary.

This geometry is extremely complex and requires very sophisticated mathematics to deal with it. The maths involved is also very elegant. We don't yet have a fully working TOE, but the work so far has

convinced physicists that the universe simply must be described by a mathematical system that is inherently beautiful. This is nothing more than an act of faith.

But even more important is what the theory tells us about reality. Since this is the ultimate mathematical description, it would be very unpleasant if the reality it described was not a thing of beauty. In this respect physicists are like the rest of us mortals – they seek a description of the world that is spiritually satisfying.

If the universe really can be described by such a lovely and complex piece of mathematics, then this raises a very interesting question, one that Einstein and Newton both grappled with in the wake of their own brilliant theories. The question is: how can something so marvellously constructed have come into being?

To Einstein it seemed that a universe ruled by the elegant laws of relativity just couldn't have happened by accident. In his wonderful explanation of gravity he saw the divine touch. The more sophisticated the mathematical model of our universe becomes, the harder it is to accept that there was no purpose, no plan, no masterful guiding hand behind its creation.

Of course there are many scientists who reject such talk. And obviously you can simply say: what is, just is. But one of the reasons why physics has become so appealing to a wider public is precisely because its theories are now giving us a picture of a universe that apparently has the stamp of a higher creative power on it.

Physics alone can never explain why things are the way they are: it can only attempt to show us how they are, and hopefully how they came into being. To answer the question "why" one must go into the realm of metaphysics. In that realm scientists become like the rest of us and can no longer count on "logic" to back them up.

But science itself isn't always a logical process. At a certain point, even physicists must go outside logic to create new theories. Einstein is especially eloquent on this subject. Speaking of fundamental principles he has said: "To these elementary laws there leads no logical path, but only intuition, supported by being sympathetically in touch with experience". And speaking of his own work he once wrote: "The state of feeling which makes one capable of such achievements is akin to that of a religious worshipper or of one who is in love".

In the long run most individuals and all societies need a spiritual

framework in which to ground themselves and their physical environment. The new ideas in physics are important for our culture because they are giving us a view of our universe that includes a spiritual component.

There is nothing in any of the theories that proves or disproves the existence of God. But they certainly suggest that our universe is a creation any divine being would be proud of.

THE NEW PHYSICS

The new physics says what A.N. Whitehead said long ago: that nature consists in the last analysis of events, not things. The old (Newtonian) physics pictured the universe and all that is in it, including humans, as machines. All that existed was matter in motion. The new physics says: "There are no particles!"

The old physics was taken up by theologians who proclaimed that the world was machinery and that God made the machinery long ago and left it to its own workings. The most important contribution the new physics has made to theology has been to show that this conception of the universe and its God is quite untenable.

The new physics has opened the door to a new way of thinking about the universe and of God's possible relations to that universe. For the most part, the new physicists proclaim the non-material nature of things.

The insoluble problem for the old physics was how mind and consciousness came to be in a universe of material. The new physics allows for the possibility that consciousness is not simply something that emerges when matter becomes very complex, as in living creatures. It allows the possibility that mind is present in some elementary form in the most fundamental entities of creation. Likewise it sees no real boundary between living and non-living.

Stephen Hawking said in his *A Brief History of Time* that the eventual goal of science is to provide a single theory that describes the whole universe. This is the Theory of Everything.

But everything in this context is not everything at all. It has to do with a theory that brings together the presently disparate theories of relativity and quantum physics. Curiously, everything in this context does not include the things that matter most – our feelings, mind and consciousness. The physicists tend to leave that out as too difficult to deal with.

But any bold Theory of Everything must include the subjective and the sentient. Otherwise it is a theory of only part of everything.

The new physics presents not only a challenge to physics itself to broaden its meaning of everything, but to theology and philosophy as well to include all in their attempts to find a meaning to God in the world of the new physics. In short, the new physics in no way vindicates classical theism. It calls for a new wine in theology fit for the new bottles of physics.

CHARLES BIRCH

SCIENCE RAISES THE BIG QUESTIONS

At the beginning of the scientific revolution in the 16th century, none of the great scientists thought that science was at odds with religion. Conflicts arose only if scientists went beyond their science and played at being philosophers and theologians, or if theologians played at being scientists and claimed that the Bible provided scientific information about the workings of the cosmos or about the evolution of human beings.

In the late 18th and 19th centuries, however, science became linked with a particular philosophical theory about science – the theory of positivism – which claimed that scientific knowledge was the only valid form of knowledge, or at least the central form of knowledge. All other kinds of knowledge – philosophical, religious, ethical – were rejected as meaningless or suspect.

Over the past 50 years, from inside and outside science, there has been a sustained critique of positivism, and an attempt to provide a more adequate account of science and the scientific method.

Despite some old-fashioned hubristic claims for science by people like Hawking, and in a different sense by Capra, the tendency has been to take a more modest view of the capacities of science and to realise that, despite all the marvels of physics and biology, science raises – but cannot itself answer – all the big philosophical and ethical religious questions.

Thinkers in the 18th and 19th centuries thought that science could save us, but not many people think that way now.

MAX CHARLESWORTH

A PRIVILEGED ADVENTURE

Stephen Hawking's book *A Brief History of Time* remained top of the best seller lists for over a year, and has sold millions of copies in hardback. Yet paradoxically, physics is the most unpopular subject at school and is dropped at the first opportunity by a majority of students. How can something so intrinsically exciting and fascinating as physics be so boring to school children?

I have been involved in popularising physics and cosmology for nearly twenty years, and I have become acutely aware of the mismatch between physics as it is done and physics as it is taught. Students gain the impression from their lessons that most science is cold, soulless and lonely, primarily concerned with the dry cumulation of facts and beset by problems of rigour and objectivity. They may even come to feel that science is dehumanising or positively anti social. This attitude is especially prevalent among girls, many of whom view physics as vaguely sinister and totally male-dominated.

I believe that many of the negative feelings about physics among students stem from the way the subject is presented. The emphasis on manipulation and control of forces, of elaborate gadgetry, and of "right or wrong" answers to very precise questions can seem terribly intimidating.

I regard physics as concerned with unlocking the secrets of nature. I tell my students that the laws of the universe are written in mathematical code, and that the job of the physicist is to crack the code and read off the messages. The fact that human beings, using human mathematics, can actually decipher nature's code, is nothing short of miraculous. We are tremendously privileged to be part of such an adventure.

In practice, doing physics is an intensely human activity, full of wonder and creativity. Most major advances in the subject have been made by imaginative leaps or good old-fashioned intuition. Above all, physics is a social activity; physicists usually work in teams, and all are part of an elaborate international network of like-minded scientists.

Surveys show that Australia is producing only a fraction of the physicists it needs. Yet public lectures on chaos theory, black holes or subatomic particles continue to draw record crowds. The general public retains a thirst for physics that is evidently not being satisfied at school or university.

I have a tremendous regard for the school teachers who are at the sharp end of this paradoxical situation. It is their job to ensure that students are both enthused and educated. There is no point in turning out youngsters who can wax lyrical on the mysteries of the cosmos, but who can't compute the path of a projectile.

The trick is to relate the necessary "spadework" to the broader picture. This can't be done by simply modernising the syllabus or using livelier textbooks. It really boils down to a question of image. All children have a natural curiosity. They love puzzles and adventure stories and mysteries. Physics is all of these, and more. Let's tell them so.

PAUL DAVIES

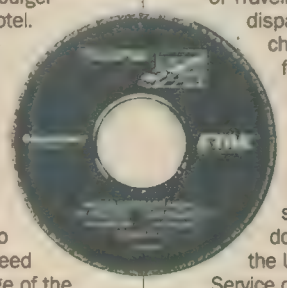
"The future isn't what it used to be."
Arthur C. Clarke

NEXT

21C's SECTION OF NEWS AND TRENDS

Drive, he said (to his car)

The way Ted Henricks tells it, he could drive some 5,000 kilometres across the United States from Los Angeles to Miami without once opening a map. All he would need to do is glance at the little computer screen of moving maps mounted alongside his dashboard, and maybe, upon his desire, slip a compact disc into the device for directions to the nearest hamburger outlet or chain hotel.



Sadly Mr Henricks, a marketing executive for the Robert Bosch Corporation, drives a straight 35 highway kilometres each workday, so he doesn't yet need to take advantage of the Travelpilot vehicle navigation system his company manufactures through its Blaupunkt unit and has just unleashed upon the American mass market.

But it is great fun he said wistfully, adding: "We would like one in every car in every garage from a sales perspective . . . but the real possibilities are maybe five to 10 years away and by then they might even talk to you – you know, 'Turn right turn left'."

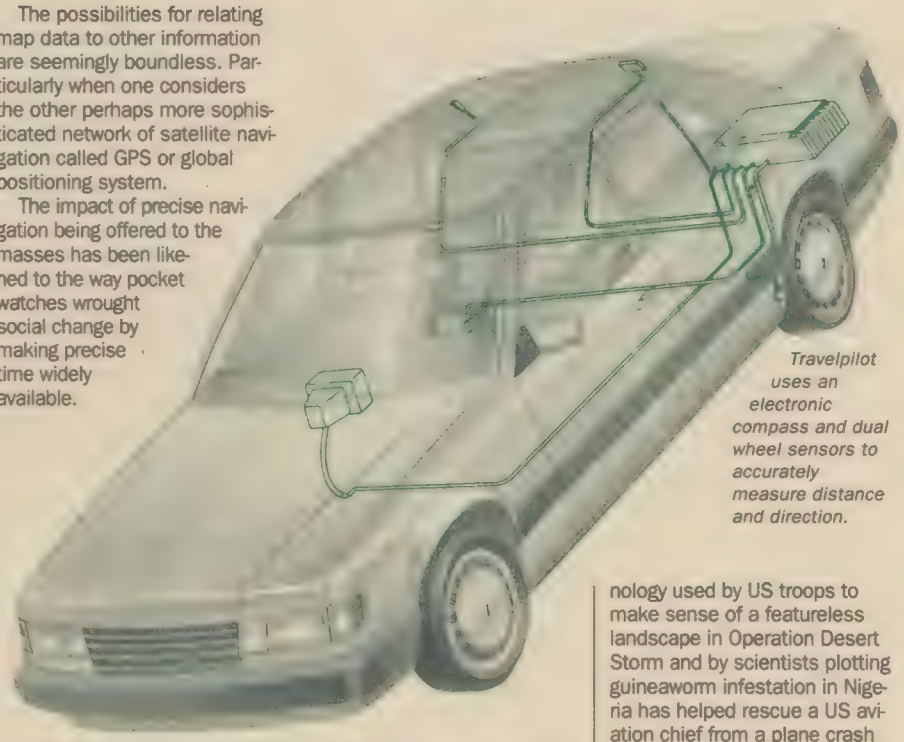
For now Mr Henricks predicts the Travelpilot, with a hefty price tag of US$3495, will sell to those people who bought the first cellular phones; the freight carriers the emergency services, people covering unfamiliar territory such as real estate agents and travelling salespeople.

He is not sure, but Mr Henricks thinks the Los Angeles fire department already makes use of TravelPilot; elsewhere dispatchers are choosing the fastest routes for Lifefleet ambulances in Florida, Burlington Northern Railroad is making sure its trains don't collide and the United Parcel Service of America is keeping track of its trucks.

The Travelpilot and others use a system called dead reckoning. It employs motion sensors and a compass to track distance and direction from an original position incorporating a technique called map-matching to improve accuracy. Pop in a compact disc of data, enter your starting point and destination – from local restaurant sites to the back roads of an unfamiliar city – and away you go.

The possibilities for relating map data to other information are seemingly boundless. Particularly when one considers the other perhaps more sophisticated network of satellite navigation called GPS or global positioning system.

The impact of precise navigation being offered to the masses has been likened to the way pocket watches wrought social change by making precise time widely available.



Travelpilot uses an electronic compass and dual wheel sensors to accurately measure distance and direction.

Pundits cited in a recent report in the *Wall Street Journal* say the new satellite navigation network – combined with advances in electronic maps, information storage and non-satellite location technologies like TravelPilot – promises to revolutionise ancient tasks.

For instance an electronic *Yellow Pages* could give directions to the nearest cinema; an air-bag attachment could automatically guide emergency services to crashed cars; an alarm system could warn oil tankers away from reefs.

Already, the same GPS technology used by US troops to make sense of a featureless landscape in Operation Desert Storm and by scientists plotting guineaworm infestation in Nigeria has helped rescue a US aviation chief from a plane crash earlier this year.

According to Mr Mike Ferguson, Montana's aeronautic authority administrator, he was rescued a mere four hours after radioing to another aircraft the precise location – courtesy of his GPS receiver – of his crashed single engine plane in

CONTINUED PAGE 20

AUSTRALIAN NEWS

Microbe caste-beater

The first sewerage plant using an Australian system of removing phosphates from the sewerage is scheduled to open by the middle of the year. Using a microbe developed by Monash University and the CSIRO, the $20 million plant in Bendigo, Victoria, will treat 20 megalitres of effluent a day. The microbe, Acinetobacter, helps to reduce the threat of envinronmental damage in sewage waste water.

Homebuyer checkout

A computer system that links real estate agents with banks and other lending institutions will be launched in NSW later this year.

Known as the Real Estate Title Exchange (RETE), it will enable prospective home buyers to walk in off the street and establish whether they are eligible for home finance, their borrowing limit and likely weekly repayments. The system will calculate all the homebuyer's financial details and immediately compute all loan requirements.

Cleverer country

If innovation is reflected in patent applications, Australia is becoming more innovative. The number of patent applications lodged in Australia continues to rise, according to a survey conducted by the Science and Technology Resource Analysis Unit of the Federal Department of Industry. And Australians are lodging more patent applications in foreign countries.

The main country in which Australians seek patent protection is, not surprisingly, the US. But there are strongly growing trends in other countries — Sweden, France, Switzerland, Japan, Netherlands, Norway, Finland and Spain.

. . . and cleverer

Australia publishes some 2.1 per cent of the world's scientific literature, according to a recent survey published by the US Science Indicators Report series. The figures, which relate to years 1981 and 1986 (the latest studied) show the Australian percentage of world scientific literature was above average in biology (4.8 per cent) and earth and space science (3 per cent).

A Green Train

The Queensland coast will rumble to an unfamiliar sight in June: the Green Train. Over a

two-week period the train, a project of the ABC, will arrive at stations from Cairns to Brisbane. Its aim is to educate and inspire Queenslanders living along the 1,700 km coastline about the environment. It will provide exhibits, displays and educational material about environmental issues. As well, ABC television and radio programmes will be broadcast from the train.

the snowy mountains of Utah. "It was as if there was a second co-pilot aboard," he said. "Would I use it again? Certainly. I'd love to own one for my new aircraft."

Mr Ferguson was only "test driving" a receiver at the time of his crash; after such a spectacular display of its capabilities he would like to see it become standard equipment.

In fact the GPS receivers initially conceived and controlled by the US military were not destined for mass market release until 1993. Enter the Gulf War.

At the outset of the US deployment of troops, less than 200 GPS receivers were in the Gulf area, said General Thomas S. Moorman Jr. the chief of Air Force Space Command at a US base in Colorado. By the end of the fighting some 4,500 had been deployed.

The military also turned to the civilian sector, snapping up less rugged receivers otherwise aimed at mariners and scientists. Since September the US Air Force is said to have purchased more than 10,000 of the lightweight cigar-box-sized receivers, with General Ronald Yates commander of the R&D agency which spearheads the satellite navigation project calling them "the hottest commodities on the Arabian peninsula". Or as general Moorman said: "GPS will become like air-conditioning. We will wonder how we ever got along without it".

During the Gulf War, troops attached receivers to dashboards of trucks delivering mail and bread. More strategically, they were used to pinpoint positions of hardware to sharpen the accuracy of B-52 bombers to help guide navy missiles to their targets to steer ships and soldiers through mine fields.

Today, GPS technology includes 16 satellites that allow people with receivers to pinpoint their positions any time, anywhere on Earth.

A GPS receiver incorporates a small computer that measures the reception of coordinated radio pulses beamed from several of the satellites. It then solves basic trigonometry problems to display a user's latitude and longitude. By mid-1993 the system should provide altitude date as well.

"The applications are just phenomenal. We manufacture different products for different applications, from rough surveying types for geologists and archaeologists who, say, want to locate oil wells for the petroleum industry, to the ones used by the military in Desert Storm"

The world-wide market for geographic information systems information is growing quickly and at least one US market research firm says sales of the systems increased 29 per cent to US$1.41 billion in 1990 and will more than double by 1994 .

After only five years in the GPS business in the US, Magellan Systems Corporation is aiming to tap into the mass market with its US$2,500 gadgets for recreational as well as commercial use. Magellan's president Mr Rahdy Hoffman said: "Our long-term vision is to see receivers in the sporting goods department of K-Mart."

Magellan's manager of sales operations, Mr Dennis Degen, said: "Recreational use? I would definitely say yes to that. It is doable for anyone who wants to know their location at any time on Earth.

"The applications are just phenomenal. We manufacture different products for different applications, from rough surveying types for geologists and archaeologists who, say, want to locate oil wells for the petroleum industry, to the ones used by the military in Desert Storm."

The Wall Street Journal reports that Japan's Pioneer Electronic Corp already is considering a hand-held device for hikers and mountain climbers. American National Forest officials are using other receivers to map trails, timber fells and fires – much easier and more accurate than a map, compass, plastic grids and a pencil.

But there is a catch: national security. Wary of giving enemies too much help the US Department of Defence can "degrade" or slightly distort the GPS signal so that it is less accurate.

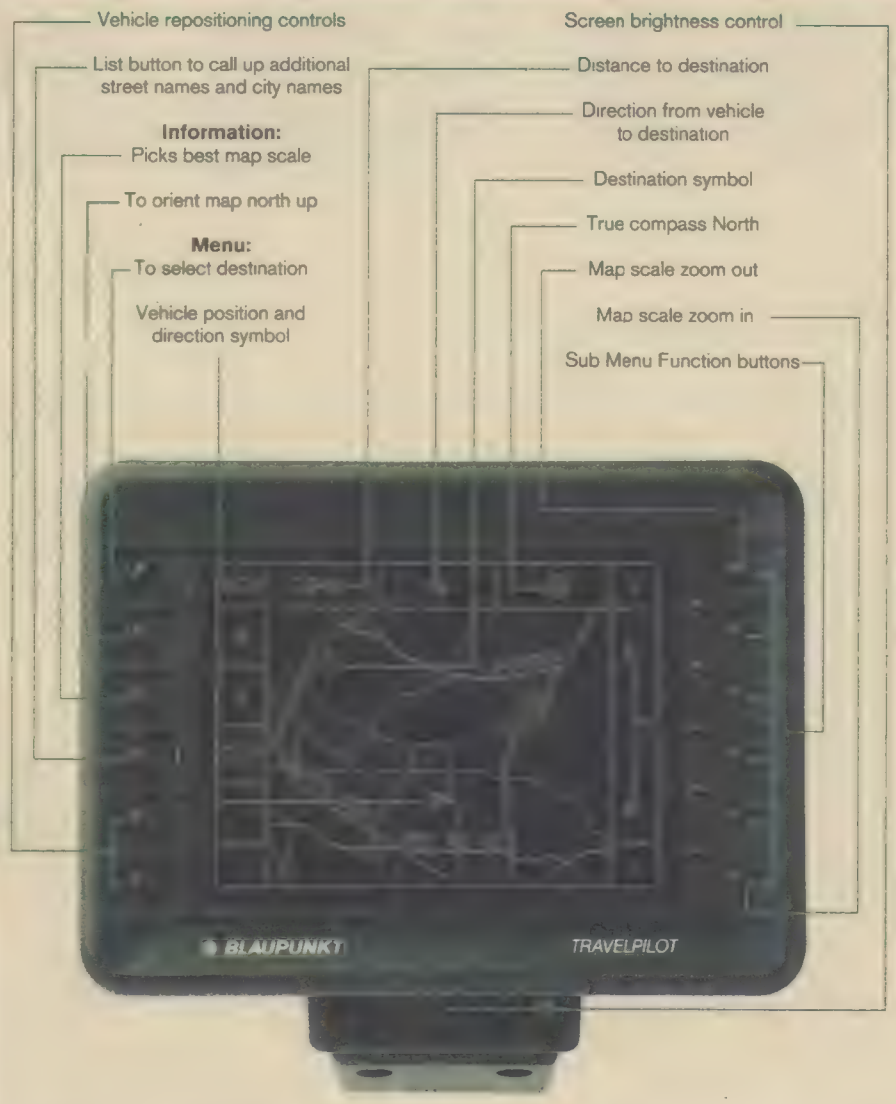
Although commercial receiver makers condemn this practice the Pentagon is sufficiently concerned that an enemy could tap into the technology and has now given access only to imprecise positioning data. This scheme called "selective availability" was introduced in March last year, but ironically was suspended during the Gulf War because US forces had too few military receivers to go around and were forced to rely on civilian models. It is sure to be reimposed.

Said one University of Colorado scientist, Mr Roger Bilham, who is using GPS data to predict seismic risks in developing nations: "The military has come up with a system that is useful to mankind. Now they don't want mankind to have full use of it."

CHRISTOBEL BOTTEN

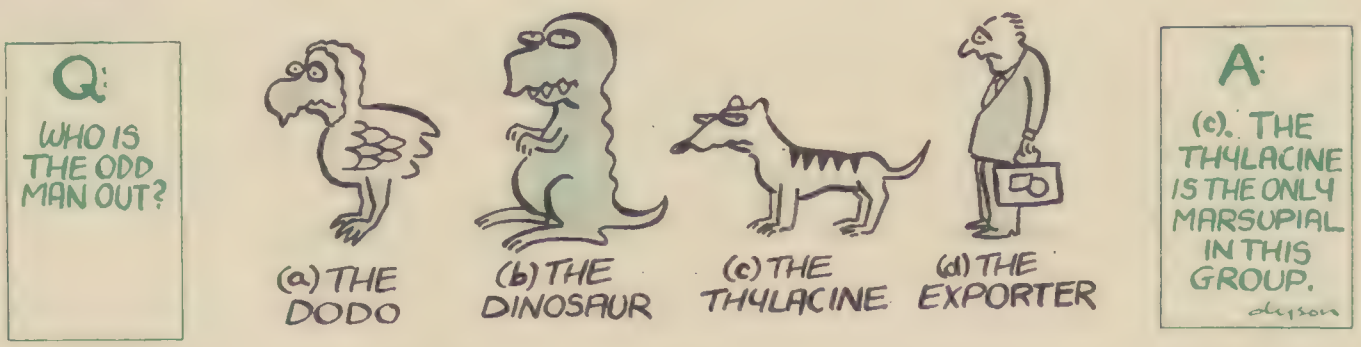
The CPU Navigational Computer is the heart of the Blaupunkt Travelpilot. Similar in size to a CD player, it can be mounted in the boot or under the seat.

HOW THE TRAVEL PILOT LEADS YOU TO YOUR DESTINATION



The Travelpilot features a small dashboard–mounted computer screen.

DYSONETICS



ENTERPRISE

Transforming waste into gold

Australia has produced a revolutionary sewage treatment technology, reports GRAEME O'NEILL

Given time, polluted rivers, streams and the oceans will eventually purify themselves. But with the world's largest cities each generating billions of litres of sewage every year, time is an increasingly scarce commodity. Sewage treatment technology has not changed fundamentally in more than half a century.

Sydney's surf beaches, polluted by partially treated sewage from an ocean outfall at Malabar, exemplify the trend. But in June last year, the Board announced it was investing in a $20 million filtration plant at Cronulla, exploiting a revolutionary sewage-treatment technology developed in Australia.

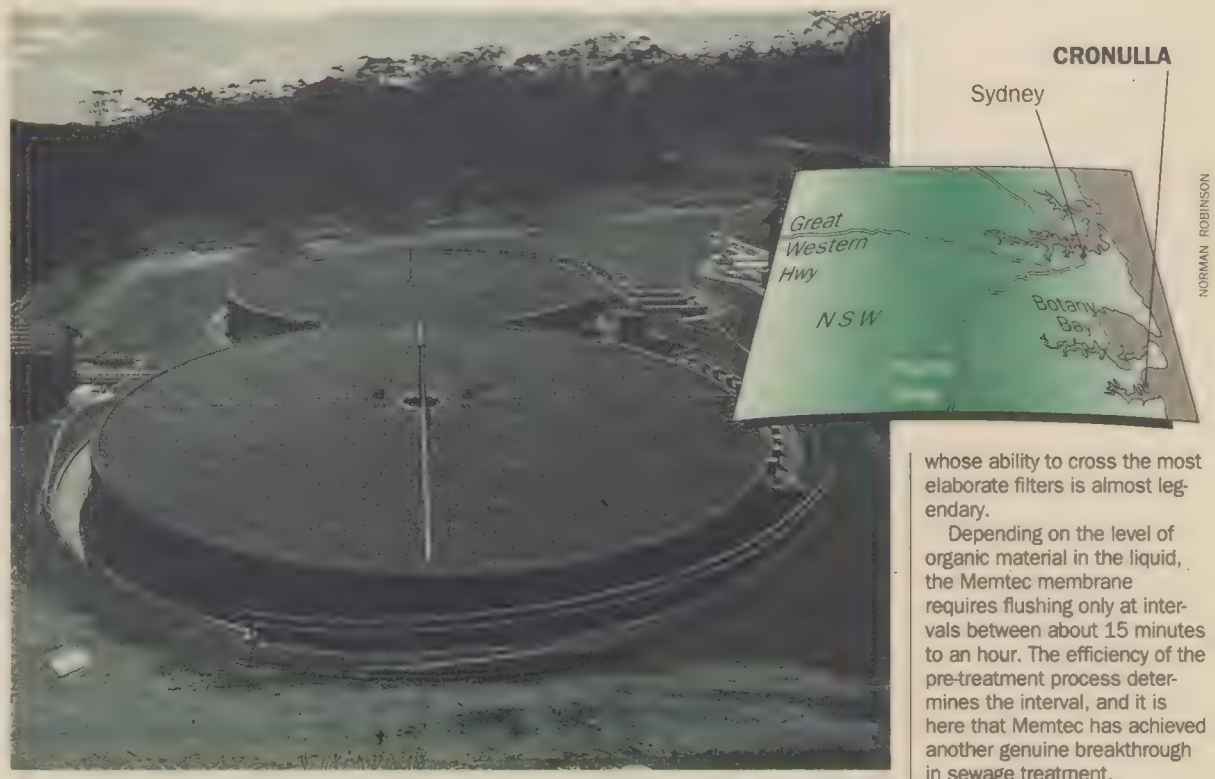
If the Cronulla plant confirms the promise shown in small-scale trials, the Membio system, developed by local company Memtec Ltd, is likely to become the sewage-treatment technology of first choice for the world's large cities in the 21st century. It destroys all microbes and strips organic materials from treated sewage many times faster than existing treatment methods, producing water pure enough to be recycled into natural waterways.

Memtec's story is typical of many Australian research-based companies. After coming up with something genuinely new and exciting, and putting in several hard years of development to make it work, Memtec ran into a wall of apathy from investors, scepticism from potential customers and the awful self-fulfilling prophecy – if it was so good, why weren't people buying it?

But Memtec's story seems destined to have a happy ending. It has weathered these difficulties and seems poised to dominate an emerging global market worth billions of dollars a year. In a world slowly suffocating on its own wastes, Memtec's unique technology has no real competition, and by the 1990's should develop into one of Australia's most important export industries.

Ironically, it grew out of a technology that didn't work in its original application. Research and development manager Dr Klint Kopp says two scientists at the University of NSW, Dr Fane and Dr Fell, had developed a prototype dialysis system for an artificial kidney machine, based on parallel-mounted nylon membranes.

They secured sponsorship for further research from US-based



With Memtec's new process, secondary trickle bed filters such as this will become a thing of the past.

Baxter Health Care Corporation, the world's largest health-care company. Out of the agreement came a joint-venture company, Memtec. But two years of tests ended in disappointment – the system proved unsuitable because proteins in blood plasma tended to adhere to the nylon membrane.

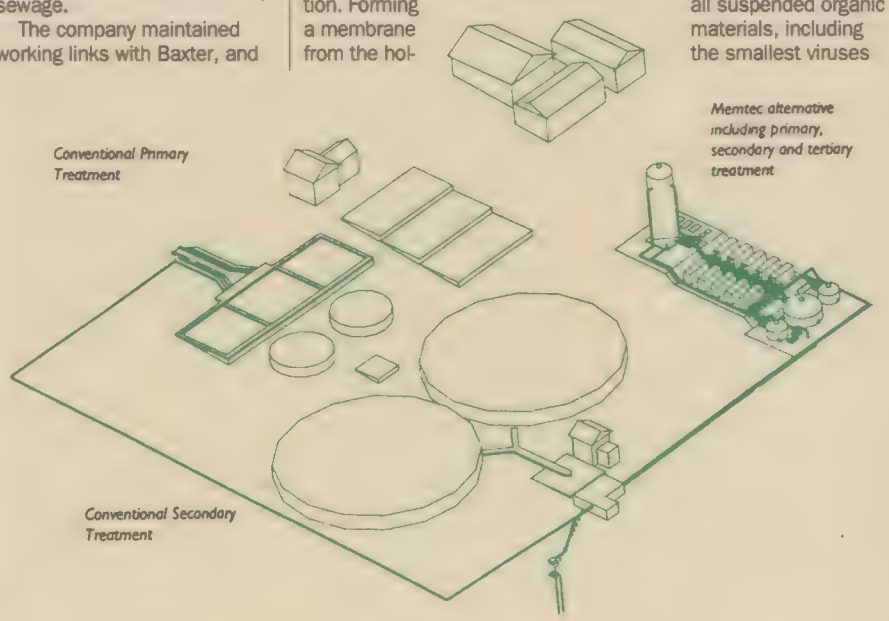
But the world was showing interest in polymer membranes for filtering liquids as diverse as fruit juices, industrial waste streams and sewage. So Baxter-Travenol managing director Denis Hanley decided with several colleagues to buy out the University and adapt their microfiltration technology for treating industrial wastes and sewage.

The company maintained working links with Baxter, and on a visit to its former parent's US laboratories, Douglas Hird, newly appointed as a consultant to Memtec, took an interest in an experimental dialysis filter made of very fine, hollow polypropylene fibres.

The universal problem with microfiltration is that membranes tend to clog with wastes. They must be flushed frequently, interrupting the filtering cycle. The only alternative is to maintain very high flow rates over the membrane, keeping the wastes in a concentrated suspension on one side. But this is expensive because it involves a large expenditure of energy.

Memtec found a unique solution. Forming a membrane from the hollow polypropylene fibres, it found it could could clear accumulated wastes rapidly and efficiently by blowing air through the fibres. The cleaning operation is completed in 10-15 seconds, so that effectively continuous filtration becomes practical.

Memtec's membranes use fibres that average 600 microns in diameter – 10 times finer than a human hair – with a 300-micron internal diameter. Thousands of microscopic pores permeate the surface of the fibre – with a diameter of just 0.2 microns, less than the wavelengh of visible light, the pores admit water and gas molecules but exclude virtually all suspended organic materials, including the smallest viruses whose ability to cross the most elaborate filters is almost legendary.



Depending on the level of organic material in the liquid, the Memtec membrane requires flushing only at intervals between about 15 minutes to an hour. The efficiency of the pre-treatment process determines the interval, and it is here that Memtec has achieved another genuine breakthrough in sewage treatment.

Conventional sewage treatment plants use an activated sludge system to remove both suspended and dissolved organics. Commonly, the wastes are slowly trickled through beds of coarse gravel. The surface of the gravel particles are coated in a slimy layer consisting of teeming billions of bacteria, which digest carbon compounds and other nutrients.

Memtec ran into a wall of apathy from investors, scepticism from potential customers and the awful self-fulfilling prophecy – if it was so good, why weren't people buying it?

According to Dr Kopp, the wastes require a residence time of several days before their organic content is reduced to a level acceptable for discharge into the environment. This residence time fundamentally limits the volume of material that can be processed, or at the higher flow rates generated by large cities like Sydney, means that a higher level of organic compounds must be tolerated.

The level of organic contamination is described by a measure called biological oxygen demand (BOD) – the amount of oxygen, in milligrams per litre of liquid, required to convert the remaining carbon compounds into relatively harmless carbon dioxide. The World Health Organisation has set a standard BOD of 10mg/l for treated

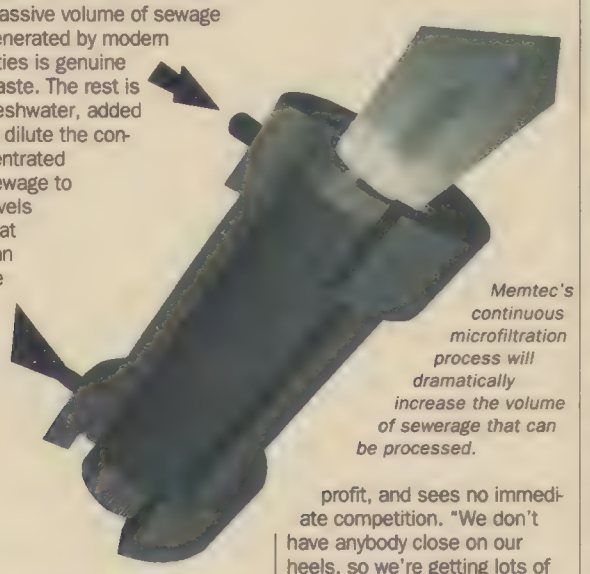
wastes. Heavily contaminated wastes can destroy aquatic ecosystems by consuming all available oxygen in the water.

Memtec's second stroke of genius was to develop an activated sludge system based on a system called counter current exchange. Instead of gravel, it uses a fine bed of anthracite (black coal) particles, averaging 2mm in diameter.

Wastes trickling down into the bed meet a rising stream of air bubbles pumped in through the base of the bed. The gentle agitation of the bed, combined with the constant supply of oxygen, drives bacterial colonies up to phenomenal levels. Residence times are reduced from two days to five minutes or less.

When combined with Memtec's membrane microfiltration technology – an arrangement that Memtec has dubbed the Membio process – the two-step arrangement permits greatly increased treatment rates, and a pathogen-free final product with a BOD figure of 5mg/l – a 50 per cent improvement on the world standard.

Just a small fraction of the massive volume of sewage generated by modern cities is genuine waste. The rest is freshwater, added to dilute the concentrated sewage to levels that can be handled by conventional treatment plants. Of the 500 billion litres of sewage discharged into the ocean off Sydney last year, 499.5 billion litres consisted of freshwater; the ratio of fresh water to primary sewage is 99.9:1



Memtec's continuous microfiltration process will dramatically increase the volume of sewerage that can be processed.

Apart from consuming massive quantitites of fresh water, it in turn generates huge volumes of waste water that must be returned to the environment. Memtec's technology could make a major contribution to water conservation, environmental preservation, and reduce the capital costs of establishing new dams and catchment areas.

In theory, the greater efficiency of a Memtec plant should achieve the same throughput as a much larger conventional plant. With many big towns and cities already heavily built-in, there is no more space to build conventional plants. A compact Memtec treatment plant offers a solution, and could greatly reduce total capital outlays.

Dr Kopp sees major opportunities around world for his company's sewage treatment system, and further opportunities in plants that would simply be used to purify contaminated water to drinking standards. He says the very low level of organic compounds achieved by the Memtec process offers another important health bonus: when chlorine is added to water to purify it and kill microorganisms, it tends to form complexes with carbon compounds – organochlorines.

Organochlorines have been implicated in the development of cancer, so by achieving a very low level of carbon residues in drinking water and processed wastes, Memtec's system should greatly reduce this risk.

"We're getting a tremendous amount of interest from the recently privatised water authorities in England," Dr Kopp said.

Memtec is already close to profit, and sees no immediate competition. "We don't have anybody close on our heels, so we're getting lots of interest," he said.

Three years ago, Memtec's technology so impressed the managing director of Japan's Kurita Laboratories, the largest private water-treatment company in Japan, that he joined Memtec's new Japanese subsidiary as president of the company. In Japan, potentially the world's most lucrative market for Memtec, business is conducted largely through personal contacts, and Mr Minoru Okazaki brought with him an extensive range of contacts in Japanese industry and academia.

Dr Kopp says sewage-treatment and water-management authorities around the world are taking a keen interest in the performance of the new Cronulla plant, the first in the world to try the Membio process. For Memtec, it is a make-or-break test – and the company is confident it can break into the big time.

NEXT IN AMERICA

More than 70 per cent of American adults believe in life after death; a quarter believe in ghosts and 18 per cent think it is possible to communicate with the dead. Meanwhile, according to the US Gallup Poll, 49 per cent believe in extra sensory perception — down from 51 per cent in 1978. But in that time belief in devils has increased from 39 per cent to 55 per cent of American adults. And while 78 per cent believe in heaven, only 60 per cent believe in hell.

SOURCE: THE GALLUP POLL

White children in America can expect to live to 75.6 years, while life expectancy for black children is 69.2 years. And blacks in America are over six times more likely than whites to be murdered, three times more likely to die of kidney failure and twice as likely to die of diabetes.

SOURCE: US NATIONAL CENTRE FOR HEALTH STATISTICS

Researchers in Seattle are trying to duplicate the fibres of spiders for industrial use. Spider silk is stronger than steel and ten times tougher than any other material, according to Christopher Viney, an assistant professor of bio-engineering at the University of Washington. If researchers could synthesize spider silk, he says, it could help build suspension bridges or flak helmets.

SOURCE: BUSINESS WEEK

The Japanese presence in US industry is growing rapidly. Japanese interests now own or have a large stake in 1,435 manufacturing plants in America – up 40 per cent since 1989 and double the 1986 figure. The estimated number of workers employed at those plants has increased from 200,000 to 300,000.

SOURCE: FORTUNE MAGAZINE

Predictions about American shopping habits in the year 2001:

➢ Instead of expecting a consumer to leave his or her home to buy a bar of soap, companies will sell subscriptions to soap. According to Faith Popcorn, chairman of BrainReserve Inc, a new bar will arrive in the mail monthly along with the bills and magazines.

➢ People will shop mostly in "powercentres", giant shopping malls made up of stores carrying huge selections of one product such as socks, soap or soup, says Chicago retailing consultant Leo Shapiro.

➢ Grocery shoppers will step into a total environmental cubicle near a product's display, outfitted with music, holographic displays and appetising smells. "All the senses will be dazzled," says Anthony Adams, vice-president of market research at the Campbell Soup Co.

SOURCE: WALL STREET JOURNAL

Our technology-led energy efficient future

A report compiled by the Commission for the Future has examined the potential for Australia's economy to increase energy efficiency through a systematic review of the way energy is used in Australia. *Towards Toronto – Australian Technological Innovations for Energy Efficient Futures* has also identified innovations and manufacturing opportunities that relate to the end use of energy.

Modern industrial societies are highly dependent on fossil fuels. Low cost resources of some of these fuels, notably petroleum, will become increasingly scarce and expensive within a few decades. In recent years the greenhouse effect, to which carbon dioxide produced by fossil fuel combustion is the largest single contributor, has made energy efficiency even more urgent.

The study concludes that:

• Australian researchers have innovated a wide range of efficient and renewable energy technologies and are abreast or ahead of international competitors in a number of areas.

• Most innovations originated with universities or CSIRO, or from small private firms. Big Australian firms are conspicuously absent in this field

• Forty-eight separate technologically proven innovations in efficient or renewable energy technologies were identified. Widespread adoption of these and other technologies is integral to achieving the Toronto Targets for reduction of greenhouse gas emissions, a 20 per cent reduction by the year 2005.

• The record of commercialising these technologies is patchy. Some researchers have already been forced offshore to commercialise their innovations due to sluggish domestic demand.

• Relative energy price structures and inefficient energy markets militate against commercialising Australian technologies for efficient and renewable energy services.

• Australian managers and workers are often ignorant of their wasteful energy practices. Managers require much higher rates of return from efficient or renewable energy technologies that cut costs than they demand of investments in production that expand revenue.

• Cultural habits in workplaces, fear of change in institutions and unfamiliarity with new technology by energy decision-makers all work against adoption of efficient and renewable energy technologies.

• The ecological friendliness, diversity, flexibility, and small scale of these technologies will increase their attractiveness in an era of environmental concern and scarce capital resources.

• Recent commonwealth and state government commitments to achieving the Toronto Targets will address many of the non-technological barriers to adoption and will increase the marketability of the innovations described in this study.

Part One of the report describes the database that is the empirical foundation of the analysis, deals with the achievements of, and prospects for, commercialising these technologies in Australia, and examines the industry and public policy commitments that are needed to ensure that Australian innovations for efficient and renewable energy are successfully commercialised.

Part Two provides forty-eight detailed individual profiles of the specific technologies referred to in Part One.

The report is part of the Commission for the Future's Sustainable Energy Futures project (Manager: Dr Peter Hayes) and is available from The Commission for the Future, 98 Drummond Street, Carlton 3053. ($8 including postage).

INTERVIEW

The Crean movement

The Minister for Science and Technology, Simon Crean, talks to NEXT

You have been Science Minister for a year. Tell us about what you have seen of the "clever country" in operation.

We come across many examples of Australia's scientific cleverness: a new treatment for ulcers that promises huge cost savings, not to mention greatly reduced suffering; genetically engineered cotton plants that produce their own insecticide, and so cut down the use of costly and environmentally damaging artificial chemicals; the prospects of developing — and I mean developing, not just digging up and shipping out the raw ore — a vast deposit of magnesite in Queensland into a whole industry based on magnesium product; alloys that will reduce the weight of cars and so increase fuel efficiency and reduce exhaust emissions; new waste management processes; maybe stronger, lighter, faster-curing cements.

How is the current recession affecting Australian research, technology and identity?

The short answer is that, nationally, we don't know. The latest figures we have, for 1988-89, show that business spending on research and development (R&D) and Australian patenting overseas are still increasing and are at about triple the levels of the early 1980s. Initiatives of this government, such as the tax concession for industrial R&D, have played a big part in bringing out this growth.

Nevertheless, I suspect that the recession is having an adverse impact, at least in the short term, on business investment in R&D, and it certainly is on the capacity of Government to increase funding for public sector research or increase support for industrial innovation.

One of the problems we face in this area is that, while attitudes have changed over the past decade, many businesses still see spending on R&D as a cost, or as a discretionary expenditure, rather than as an investment that is absolutely essential to long-term survival and profitability.

"The greatest task facing Australia is recognising that the most important commodity in the 21st century will be knowledge"

I suspect that the recession may be one reason why the CSIRO has not been able to attract an Australian partner in its remarkable "gene shears" technology, which provides the means to switch off specific genes in plants and animals, offering exciting prospects for improving plant varieties and controlling viral diseases such as AIDS.

In ten years' time, by 2001, what are the key things Australia must have done to ensure its success as a country in the 21st century?

Most people would answer a question like that in terms of macro- and micro-economic reforms: low inflation, higher savings, reduced foreign debt, more efficient services, more flexible labour markets, and so on. People will argue forever about what are the most critical factors holding Australia back.

I would argue that the greatest task facing Australia is recognising that the most important commodity in the 21st century will be knowledge, and the most important capability will be that of accessing, creating and using knowledge. Having and using knowledge will determine how well nations adapt, survive and prosper in a global environment characterised by accelerating change and increasing uncertainty — economically, environmentally, socially.

Australia needs to develop a culture of cleverness that recognises the value and virtue of things like education, training, research, enterprise, creativity, flexibility and innovation — in all areas. Nations that don't have these qualities will be increasingly disadvantaged and suffer increasing hardship.

How can Australia become a centre of scientific and technological innovation? What are the specific requirements to achieve this?

I think that, relative to our size, we are already a centre of scientific and technological innovation. In some research fields we are world class: the Japanese, Koreans, French and Germans are interested in collaborating more with us in research. Our agricultural and minerals industries are among the most efficient and innovative in the world.

We need to build on this. The government has devised a science and technology strategy based on three goals: excellence, co-operation and application. Elements of the strategy include:

- A continuing commitment to longer-term fundamental and strategic research (demonstrated, for example, by the new $100-million-a-year Co-operative Research Centres [CRC] Programme);
- Better co-ordination of our science and technology effort (through, for example, the Prime Minister's Science Council and a White Paper on science and technology being prepared for 1992);
- Stronger linkages between major components of the science and technology system. (The CRC Program is again relevant here, as are the initiatives to encourage business R&D);
- Closer integration of science and technology policy with other policy areas, for example, industrial development and sustainable development (reflected in the March Economic Statement and the ecologically sustainable development working groups process); and
- Greater community awareness of the role of science and technology in Australia's future.

What does the term "clever country" mean to you?

To me, a clever country is one that knows its strengths and makes the most of them; and knows its weaknesses and attempts to rectify them. It is a country that recognises it must work harder and smarter to meet the challenge it faces, a challenge faced by all countries, but made greater in Australia's case by its heritage, history and geography.

60 years on, a world of wealth (and cars)

A sneak preview of what the United States and the world will be like in the middle of the next century is offered in the US Institute for the Future's latest 10-year forecast produced for its corporate associates in late 1990.

The proprietary report has traditionally concentrated only on 10-year forecasts, but this report is special in that it is the first to "touch" the 21st century. Therefore, "with considerable humility and trepidation, we decided to generate for the publication's centre section an initial glimpse of the first half of the 21st century," says Karen Haserot, editor of the Institute's newsletter *Perspectives*.

While a 60-year forecast is unlikely to prove very accurate, the Institute felt that a long-term view of the future would help to sharpen the focus on the 10-year forecast that makes up the bulk of the report. Among the possible features of the year 2050 the Institute foresees:

- U.S. society will have grown to remarkable levels of affluence, with GNP tripling from present levels.
- Traditional world cities such as New York, Tokyo, and London will be surpassed in size by a host of new "megatowns".
- National governments will not be abandoned, but regional groupings (e.g., the European Community) will gain more power in Europe, Africa, and Asia.
- Cars will still be around (as opposed to Jetsons-like personal helicopters); however, we may use them less, and they will likely be fueled by something other than gasoline.

SOURCE: THE FUTURIST

AUSTRALIAN INNOVATION

Cytokines and Alzheimer's, or the re-getting of wisdom

Most cell types in the body are replaced many times during an individual's lifetime. But nerve cells – neurons – are irreplaceable. Mature neurons cannot divide to create new cells and, if damaged, have a limited capacity to regrow or reconnect. Nerve diseases like Alzheimer's disease cause the mass death of neurons, eroding higher brain function, while motor neuron disease destroys the connections between the brain and the muscles, causing paralysis. Both are incurable.

However, recent experiments suggest that it may one day be possible to treat, even to cure diseases of the nervous system using compounds called nerve growth factors, which occur naturally in the body. Nerve growth factors (NGFs) are specialised molecules belonging to a much larger class of compounds called cytokines (Greek: "cell activators"), which regulate processes such as cell division, maturation, maintenance and even cell death.

At Melbourne's Walter and Eliza Hall Medical Research Institute, Dr Perry Bartlett's research team has shown, for example, that a cytokine called LIF will induce isolated precursor cells taken from embryonic rats to grow and develop into mature nerve cells. The cells come from a region known as the neural crest, which appears very early during development, and which eventually forms the elaborate nerve pathways that connect the brain with its sensory systems and the muscles of the body.

Dr Bartlett's team is attempting to define which NGFs are involved in establishing these nerve pathways and maintaining them in working order throughout life. It is known, for example, that every cell of every muscle in the body is served by its own neuron; early in development an embryo possesses about twice as many neurons as it actually needs to make these elaborate connections. Surplus neurons are allowed to die – perhaps by the selective withdrawal of an NGF involved in their maintenance.

Other NGFs like LIF mediate the complex process by which the primitive precursor cell are induced to divide, grow and turn into mature neurons. A deeper understanding of these processes could eventually lead to the identification of NGFs that could be used to repair nerves damaged or severed in accidents. It may be possible to develop early-intervention therapies that would halt neuron damage and death in patients with Alzheimer's or motor neuron disease – and perhaps even to restore some of their lost nerve function.

These are not trivial matters. Alzheimer's disease, for example, costs the Australian economy hundreds of millions of dollars a year through the loss of skilled workers, and the enormous costs of providing the constant nursing care required in the advanced stages of the disease.

GRAEME O'NEILL

For your information

BARRY JONES

In recent years there has been an "information revolution" — an extraordinary increase in the amount of available, storable and retrievable data transmitted by technology like telephones, computers, television and satellites.

Media coverage of the Gulf War tellingly illustrates the phenomenon: wall-to-wall coverage, hour after hour of vividness and immediacy. We were so awash with information that we almost drowned in it.

But the Gulf War experience is a kind of parable about the information explosion: vast in quantity, but what about the quality?

Information is readily available, whole megabytes of it, at strikingly reduced unit cost. Computers are found in primary school classrooms, and the television screen is the unblinking window on the world in every household, virtually the third parent, far more significant than the traditional two in shaping ideas and values.

Australians are great users of information technology and its products. Prodigious expenditure on computers, scientific instrumentation and sophisticated office equipment is – speculative borrowing by our great entrepreneurs aside – the largest single factor in our adverse terms of trade. While we use "state of the art" equipment, we don't generate much activity with it, certainly little that is tradable.

"In 1985, I was enthusiastic about promoting discussion on a National Information Policy. Seminars were held and a useful booklet produced. The Canberra bureaucracy loathed it and wanted it shredded"

Although Australia is an information society in which more people are employed in processing information, broadly defined, than in agriculture, manufacturing and construction combined, this has evoked virtually no policy response at all. Governments have been extraordinarily slow to grasp the significance of the growth of the information labour force, now so large and homogeneous as to require recognition as a separate sector in labour force statistics.

The conventional three-sector analysis of the labour force, used since the 1940s, is now obsolete and irrelevant. To be told that employment falls into three sectors only — primary (agriculture and mining: 5 per cent), secondary (manufacturing: 15 per cent) and tertiary (services: 80 per cent) — fails to answer the basic question: what are people actually doing? To treat 80 per cent of the labour force as a mere residual category is as pointless as recording religious statistics for Australia as Jewish one per cent, Moslem two per cent, Others 97 per cent.

Who makes up the information sector? People who work essentially with symbols (words, numbers, sounds, images) or symbolic objects (cheques, banknotes, title deeds, insurance certificates) and whose tools of trade are pens, pencils, telephones, computers, cameras, test tubes, measuring instruments. Information workers include teachers, librarians, public servants, actors, journalists, lawyers, scientists, clergy, Telecom and Australia Post employees, workers in banking, insurance, advertising and promotion, politicians, economists, photographers and authors.

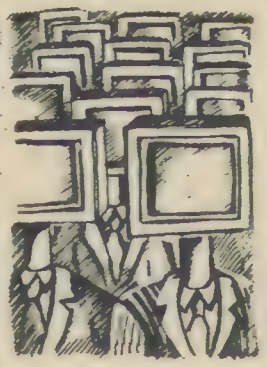
In my analysis of 1986 Census returns published in the 1990 edition of *Sleepers, Wake!*, I concluded that 38.73 per cent of Australians actually in work should be classified in the information sector. By 1991 this figure is probably above 40 per cent. The Australian figure is lower than the US and Canada, a little ahead of New Zealand and roughly equivalent to Britain, most nations in western Europe, and Japan.

Growth in information employment was largely unexpected, unplanned for, and certainly not the result of long-term labour force planning. When the 40 per cent figure is raised in conversation people can hardly believe it, even when they work in the sector themselves. Old stereotypes die hard. Ask a typical Australian politician or journalist to identify a typical Australian worker and the answer will almost invariably be somebody employed in manufacturing, just as a generation or so earlier a shearer might have been identified.

If we have only the vaguest idea about employment in an information society, we have even less about the significance of information as a factor of production, or its political significance. Political and bureaucratic responsibility for information-related issues is dispersed, with some of Canberra's great barons hanging on to important segments. To the Department of Industry, Technology and Commerce, "information" means "information technology" — hardware and software, its availability, the economic issue of how far national self-sufficiency can be promoted. To the Department of Transport and Communications, "information" means the administration of communications systems – licensing of radio and television networks, running the telephone systems, AUSSAT and OTC. With the recent debate within Cabinet and the ALP National Conference about the principles of public v. private ownership in telecommunications, major issues had to be thought out on the run, in the context of political damage control, because there was no broad policy approach to these issues, and the parliament appeared to have taken a collective vow of silence.

The Department of Arts, Sport, Environment, Tourism and Territories (DASETT) has responsibility for one important institution, the National Library of Australia, but not for the provision of information-library services and standards generally. The Department of Employment, Education and Training (DEET) has responsibility now for research (leaving aside CSIRO and DSTO), but the broad principles for encouraging research in Australia and its relationship with other information areas are far from clear.

Where new and potentially controversial issues such as foreign ownership of newspapers arise, they have a stunning novelty because we are used to making decisions on the run, as a form of crisis management, and not used to looking at them in a broad policy context.



KAT PLASTARAS

Back in 1985, as Minister for Science, I was enthusiastic about promoting discussion on a National Information Policy. Seminars were held and a useful discussion booklet produced. The Canberra bureaucracy loathed it and wanted it shredded. Information flow about the subject of information flow was regarded as potentially dangerous. The document was published only after I drew on some political IOUs with my ministerial colleagues.

The Ministry of Science was vaporised in 1987, as part of government policy to get research back into the real world of the Australian corporate sector, well known for its vision and long-term commitment to excellence. Work on a National Information Policy was then abandoned.

By 1990, however, there was growing recognition that information was far too segmented to allow for appropriate policy responses. When the House of Representatives Standing Committee on Long Term Strategies was established in May 1990, I suggested nine possible areas that could be the subject of inquiries. To my surprise — and without too much prodding by me — the committee decided to inquire first into "Australia as an Information Society".

Now I understand why the committee made its choice. As parliamentarians, the committee's members are conscious of the problems of access and equity in information matters in their own electorates, with a widening gap between the "information rich" and the "information poor".

They also recognise that, as MPs, they are "information rich" relative to their own constituents, but "information poor" relative to the bureaucracy. If MPs sit in Canberra for only 38 days each year, but public servants are there for 365 days, you don't have to be Einstein (or Madison) to predict the relative distribution of power.

Moreover, MPs are conscious that vital decisions about information are taken in a policy vacuum. They recognise that the area is important but nobody, so far, takes political responsibility for it.

Several major questions demand answers. Is information a public good, freely available, or an area for profit? Does the internationalisation of information threaten national autonomy? And are privacy and ready access reconcilable?

So far, 95 submissions, some of major length, have been received from organisations and individuals, and up to 30 more are expected. Seven public hearings have been held. Most of the submissions reflect the long-standing fragmentation in information: librarians push library interests, archivists talk about archives, computerists about computers, the welfare lobby about welfare issues.

The committee's task is to bring these sectional interests together and persuade the political parties, the community at large and government to recognise the extent and diversity of the problems and act on its report promptly.

And perhaps the Long Term Strategies Committee may decide to present its first report on video – entirely appropriate for the subject matter.

WORKS IN PROGRESS

A round-up of current Australian research, compiled by PETER POCKLEY

To the edges of heaven with IRIS and SUSI

IRIS and SUSI sound like exotic creatures. In fact, they are two new, world-leading instruments developed by Australian stargazers in their continuing search for objects in the universe which will reveal more about our cosmic origins.

IRIS, the world's most versatile camera for seeing in the dark, has opened a whole new window on the southern heavens for teams of Australian and British astronomers using the 3.9 metre Anglo-Australian Telescope (AAT) on Siding Spring Mountain near Coonabarabran in north-western NSW. With IRIS fitted, the AAT has been probing the secrets of supernovas, galaxies and star-forming "nurseries".

The new window, in the infra-red region of the electromagnetic spectrum, is invisible to our eyes and was also to the AAT which had been confined to observing only in optical wavelengths. Now, IRIS has extended spectacularly the AAT's capacities as infra-red observations have begun to fill in part of the spectrum between optical and radio wavelengths.

IRIS is looking at galaxies at the edge of the universe. As galaxies move away from us their radiation is shifted towards the red end of the spectrum. But the most distant ones are moving so fast that their signals have moved out of the optical region and only reach us in the longer infra-red or radio wavelengths. IRIS also allows the AAT to look at brown dwarf stars which are too cool to radiate in the visible part of the spectrum.

Pictures already obtained with IRIS have unprecedented clarity.

IRIS works like a video camera and is a major advance on previous infra-red instruments which only gave crude measures of the total amount of radiation falling on a single detector — "like looking through a straw," said project leader, Dr David Allen.

Also in the north-west of NSW, near Narrabri, it can study the light from stars in higher detail than any other instrument.

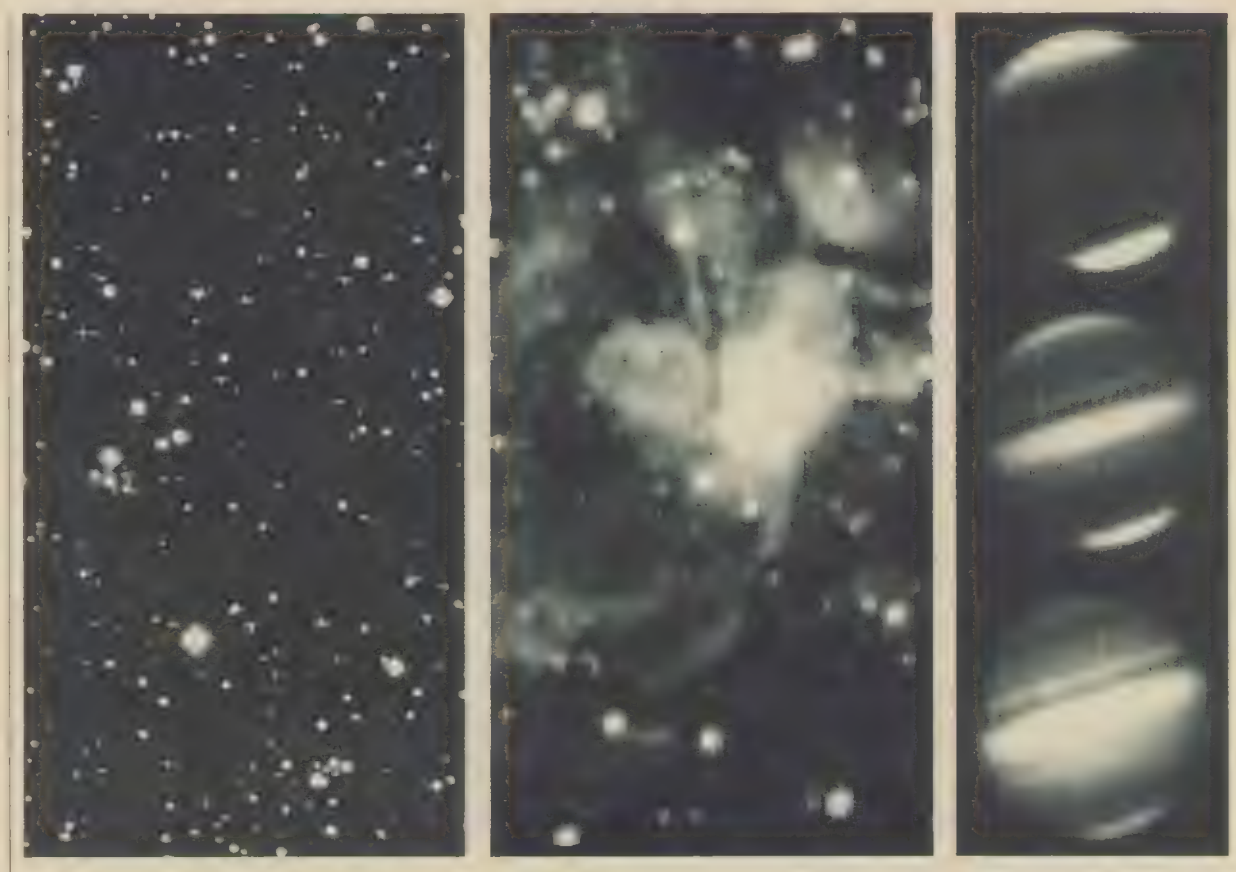
Normally astronomers have to build telescopes with larger and larger mirrors to see more detail in stars, but there soon comes a physical limit beyond which engineering and cost prohibit further enlargement of instruments.

To achieve its astonishing capacity of "resolving" detail equivalent to observing a human hair at a distance of 100 km, SUSI's design uses the principles of interferometry to combine electronically the signals of 12 small mirrors spread over 640 metres.

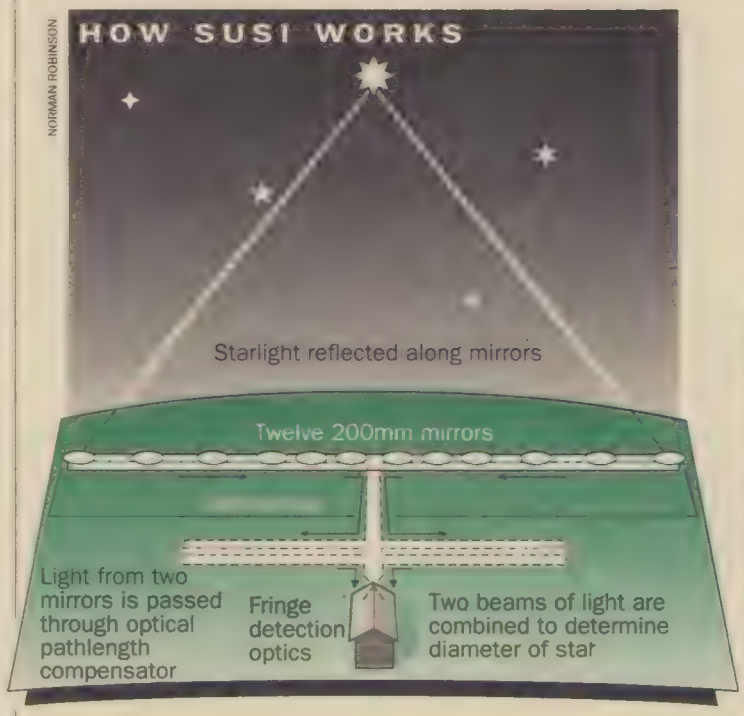
Designed and operated by Sydney University physicists, headed by Professor John Davis, SUSI does not produce pictures of stars but mountains of numbers which will allow scientists to study the temperature, size, mass and energy output of stars and even how their atmospheres and innermost structures are made up. More than 100,000 stars are within SUSI's reach.

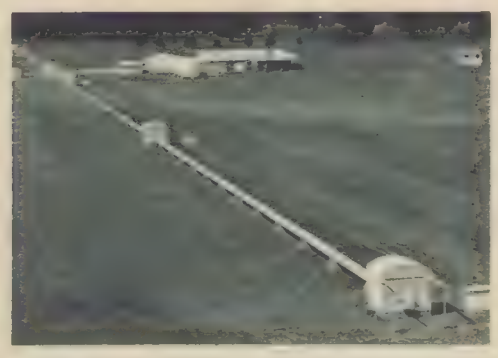
A long-term aim for SUSI is to help refine the distance scale used to measure the size of the universe.

The so-called "Hubble constant" is a number on which much of cosmological theory is based — but it has so far defied accurate estimation.



Above left and centre: First infra-red pictures of objects in the southern sky by IRIS reveals one of the largest nurseries of stars in our Galaxy, G333.6-0.2. There is a rich structure of glowing gas in the infra-red (right) from which stars are born. In a picture of the same region taken in the wavelengths of light (left), intervening gas and dust completely obscures the glowing gas. Above right: Jupiter's face changes in the infra-red, the familiar band disappearing as longer wave-lengths are used. Gases in the atmosphere absorb sunlight that otherwise would be reflected back to Earth as light.





SUSI: Sydney University Stellar Interferrometer, Narrabi, NSW

Making (sound) waves

The oceans reverberated over seven days early this year as sound was transmitted around the world for the first time in a pilot experiment for monitoring greenhouse warming of the oceans. While US and Australian scientists (from the CSIRO division of oceanography in Hobart) triggered vibrators in sub-Antarctic waters, 19 underwater stations listened as far afield as Bermuda, India, California, Christmas Island and Antarctica. All picked up the sound clearly and on cue.

The signals took about three hours to reach Bermuda. The sound was produced by vibrating sheets of aluminium metal suspended 250 metres beneath the US Navy research vessel Cory Chouest at 57 cycles per second, a frequency chosen to minimise interference from shipping, breaking waves and whales. The vessel was 80 km south of Australia's Heard Island, midway between Western Australia

and South Africa.

The speed of sound through water is acutely sensitive to changes in temperature and pressure. A temperature change of one-twentieth of a degree alters the transit time from Heard Island to Bermuda by 150 thousandths of a second.

Heard Island was ideally placed to allow sound to travel most of the way around the world. In a longer-term experiment for monitoring ocean temperatures, three or four sites would be used for permanently moored transmitters powered from nearby land bases. Temperature monitoring would have to be conducted over at least ten years in order to identify any long-term trends.

SOUND WAVES MONITOR GREENHOUSE WARMING OF OCEANS

Charge off the old block

The most detailed coverage of a whole continent by geomagnetic sensors has revealed beneath the surface of Australia the longest natural electric current in the world. Found from preliminary analysis of signals from 54 temporary geomagnetic observatories, the current is more than twice as long as one in North America.

The path of the Australian current covers 6,000 km in a vast loop from Broome in the north-west of Western Australia down through South Australia and northwards into Queensland and out to the Gulf of Carpentaria. The current runs from 15-30 km beneath the surface across a width of 50-200 km.

Although the current is not an alternative source of electrical power — it is insufficient to light a domestic lamp — the giant electrical conductor has both basic and applied significance, according to its discoverer, Dr Francois Chamalaun of Flinders University in Adelaide.

Electricity is induced by changes in the earth's magnetic field which varies daily with temperature and magnetic storms due to sunspots. The resulting underground currents flow well through sedimentary basins and through salty water left in cracks from movements of rocks.

The current runs between the ancient geological blocks which formed the continent of Australia in Pre-cambrian times, passing through the sedimentary basins between these blocks. A sub-branch of the current goes around the southern-most block. The basins contain all of Australia's producing, and some prospective, oil and gas fields.

Dr Chamalaun believes ten years of detailed analysis of the data are needed. "What the conductor probably says is that there is an underlying structure which is potentially fundamental to finds of oil," he notes.

In search of the world's body

The idea, known as the "Gaia" hypothesis, that the entire globe and all the living things populating it form a giant, self-regulating, super organism was proposed by English scientist, Dr James Lovelock. His concept first attracted disbelief among many scientists.

But, like any good theory, Gaia has led to proposals by which its truth could be tested. Lovelock and others predicted that, if Gaia is true, the microscopic plants or phytoplankton, which are abundant in the ocean, would help to regulate the climate. They said a gas, dimethyl sulphide, given off by the phytoplankton as they decay would be changed chemically by the oxygen in the air to produce compounds of sulphur.

These particles, it was suggested, would form the aerosols necessary to form the fine particles required for formation of clouds. Completing the feed-back cycle, the clouds would shield the surface of the earth by reflecting excessive amounts of radiation from the sun and limiting the growth of the plankton.

Now, research by scientists at CSIRO's division of Atmospheric Research in Melbourne has established a clear link between the dimethyl sulphide formed from the marine plants and the formation of clouds over the sea. This suggests the existence of a kind of massive, biological thermostat controlling temperatures on the surface of the earth.

For 20 months the team, led by Dr Greg Ayers, examined the particles in the air over Cape Grim on the north-west coast of Tasmania, an excellent site for studying the marine air of the "roaring forties" which are free of pollution, including sulphur, from cities. The key finding was that the levels of dimethyl sulphide and sulphur-bearing particles in the atmosphere moved in step. Both were high in summer and low in winter.

But Dr Ayers is more cautious than some scientists about the capability of nature to cope with changes like the greenhouse effect: "Our work is a signpost in the direction of Gaia, but the results do not go far enough to vindicate the whole thermostat theory."

THE AUSTRALIAN ELECTRIC CURRENT

And the winner's topics are . . .

Following a competitive selection procedure, and amidst equally intensive speculation, the federal government has chosen the first 15 of its new Co-operative Research Centres from a field of 120 applicants.

Each centre will combine the resources of at least one university, CSIRO, industry and some state institutions. The aim of the scheme is to focus high quality research on national priorities by bringing academic researchers and industry together in the commercialisation of science and technology.

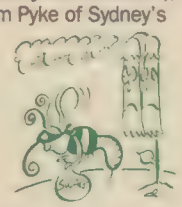
The topics of the first batch of centres are: Aerospace Structures; Antarctic and Southern Ocean Environment; Cellular Growth Factors; Extractive Metallurgy; Eye Technology; Intelligent Decision Systems; Mining Technology and Equipment; Petroleum Industry; Plant Science; Robust and Adaptive Systems; Soil and Land Management; Temperate Hardwood Forestry; Tissue Growth and Repair; Tropical Pest Management; Waste Management and Pollution Control.

On average each centre will receive, government funding of $2 million annually, which will be matched by equivalent resources from the partners.

Proof: There is *no* free lunch

A plant has attracted international attention through research giving some remarkable insights as to how nature balances energy consumption with biological benefits. The delicate red and yellow flowers commonly known as Christmas bells provided the first demonstration that production of nectar entails a cost to a plant in terms of its growth or its reproduction.

Unusually in a specialised scientific paper (in the London-based journal *Nature*), Dr Graham Pyke of Sydney's



Australian Museum uses concepts of economics — cost-benefit, trade-off and currency — to describe the process. "Both the gains and the costs associated with nectar production may be estimated in the same currency," he wrote.

Nectar is the sugary substance which attracts insects to flowers so that a few of the insects disperse pollen and seeds for propagation. The production of nectar may use up to 37 per cent of a plant's energy.

Native to NSW, Christmas bells — botanical name *Blandfordia nobilis* — are visited by nectar-feeding honey eaters and honey bees which collect pollen.

Dr Pyke studied the production of nectar by excluding insects from selected flowers with mosquito netting and ants were kept away with a proprietary chemical. He found the cost of nectar production is that the plant has a reduced ability to set its seed.

When Christmas bells were regularly "milked" of their nectar, they were forced to increase production above normal and the outcome was a lower production of seed. The presumed trade-off is the advantage of increasing the transmission of pollen by attracting more insects to the nectar-rich flowers. The conclusion? There are no free lunches in nature!

Californian contradictions

If you believe, as I do, that California now is Australia in five years' time, then it is useful to keep California under close observation and learn from the patterns it displays. That's why I try to go there at least once a year, and not — as my friends cruelly suggest — because of the great restaurants.

Think about the parallels between the two societies. Each is an immigrant community on the Pacific rim, blessed by the climate, obsessed with environmental issues, alarmed by the growth in crime and cynical about its politicians. The differences are only a matter of time — California's population is 30 million, its wealth is massive, and its ethnic mix means that people of Anglo-Saxon origin now make up only 50 per cent of the population.

DAVID DALE

Over the past 100 years, California has been the laboratory of new ideas for the western world, for better and for worse. It gave us the silicon chip, jeans, the tax revolt, the movie business, hippies, Mickey Mouse, personal computers, freeways, new age consciousness, biotechnology and jaccuzis.

But the problem with using California as a crystal ball for future trends in Australia is that you can't take your eye off the ball for a moment, or the image will have changed. Californians are contradictory creatures; they veer wildly in their enthusiasms and their aversions. One minute they are building freeways and passing referendums to force the government to lower taxation, and the next they're passing a referendum to impose a nine-cent-a-gallon tax on petrol to finance the rebuilding of the state's railway system.

But at least that particular reversal took ten years — the tax revolt was in 1979, and the referendum to raise public transport taxes was in early 1990. What's happening now is that the double reverse back flips can occur within six months.

In the middle of 1990 I spent a month in California talking to sociologists and demographers about the ideas emerging there that were likely to influence Australia. I came back and fearlessly predicted that California was about to undergo a green revolution just as far-reaching as the tax revolt of the previous decade, that it was entering a period of "neo prohibitionism" in which alcohol would be increasingly treated the way cigarettes had been in the 1980s, and that it would elect a radical Democrat named Diane Feinstein as its new governor, overturning the era of conservatism that began with Ronald Reagan.

I had been impressed by the observations of Kevin Starr, former Chief Librarian of San Francisco and author of four books of social history about California. He told me: "Certain ideas take on momentum here, and they don't proceed through stages of brokered arrangements the way power is usually exercised in political systems. Every so often a consensus forms around an idea and it becomes unstoppable. Twelve years ago it was that taxes were too high. It started the tax revolt, and it got Reagan elected. Now the idea is saving the environment.

"Environmentalism provides an encompassing mythology, theology, ethos, politics, a way of being. In the 1960s the sexual revolution became a whole way of life. Now environmentalism represents that same kind of liberating release that galvanises the thinking Californians and gives them purpose.

"And there's another idea of the moment; it's time for a woman governor. You watch. It will get Diane Feinstein elected."

The significance of Diane Feinstein was that she was the first politician to recognise that what used to be called "the minorities" — women, blacks, Hispanics and Asians — were the majority, and to guarantee that they would receive jobs in her government in the same proportions as they appear in the population (thereby turning Anglo-Saxon males into an angry minority). She was also a believer in a woman's right to have an abortion if she chooses, and a supporter of a referendum called "The Big Green" which would have resulted in bans on a wide range of common agricultural chemicals, a drastic reduction in logging in the state's forests, limits on the emission of gases that cause global warming and a rapid phase-out of ozone-damaging chemicals.

When I returned to California last January, I discovered that Diane Feinstein was not the new governor. She had been defeated in the election by a Republican named Pete Wilson. And the Big Green referendum had also been lost, along with a referendum to impose a tax on alcohol sales to finance anti-alcohol education programs.

MICHELLE RYAN

How had I (and Kevin Starr) been so wrong? All the opinion polls had shown strong support for Feinstein and for the social reform referenda. The explanation was easy to find. Between June, when I was collecting my data, and late November, when the election took place, a new word had entered the everyday conversation of Californians, as it had done with Australians at the same time. The word was recession. As the American economy slowed down, the opponents of The Big Green launched a television campaign claiming that a ban on pesticides and fertilizers in California would massively increase the cost of fresh fruit and vegetables, and that companies would have to sack workers in order to afford the proposed gas emission controls.

"... the problem with using California as a crystal ball for future trends in Australia is that you can't take your eye off the ball for a moment, or the image will have changed"

Similarly, the opponents of Diane Feinstein were able to convince the voters that her affirmative action policies would be too expensive. The minorities she was trying to help did not bother to vote, and she was rejected by the white middle class, who are apparently only prepared to exercise their liberal consciences when the economy looks healthy.

Would we behave any differently? And will we follow the latest trend emerging in California — an obsession with crime control? The voters enthusiastically supported referenda to widen the application of the death penalty, to speed up court hearings by limiting the rights of defendants, and to spend billions on building more prisons. California now has more people in jail per head of population than any nation on earth. As the wealthier Californians (and there are a lot of them) see the homeless people in their streets and the growing desperation of the poor, they are moving to protect their privileges.

The sociologists foresee the growth of a two-tier society. At one level will be an ageing population of whites and a few Asians, living in suburban or rural enclaves with private security guards. At the other level will be a growing "underclass", mainly of inner city blacks and Hispanics, working for Third World wages while their children deal drugs and kill each other in gang warfare.

Of course, we're not Caifornians. So we have nothing to fear from that example. Well, not for five years or so, anyway.

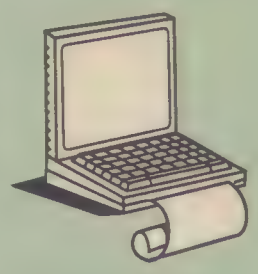
JAPAN, INC.

Technological developments in Japan, not surprisingly, are occurring across a range of industries and disciplines. This "scoresheet", compiled by *New Technology Week*, provides a forecast for 1991:

ELECTRONICS
• Although Japanese investments are slowing due to tighter finances, most companies are still cash-flush and investing for the long haul, especially in software, networking and new R&D centres.
• MITI and the Ministry of Education are aiming to expand computer use to all elementary schools by 1992. Market access, especially the TRON standard, will remain a major political issue.
• Japanese patents could reach 23-25 per cent of all US patents filed by next year, raising concerns over US competitiveness and equal access to the Japanese patent system.

SEMI-CONDUCTORS
• The memory chip slump will force more Japanese chip makers to diversify out of memory chips and into higher value-added products such as RISC (reduced instruction set controller) processors, video compression chips and fuzzy logic controllers.
• Fuzzy logic will be used to develop new voice, handwriting and image recognition capabilities in PCs and work stations, potentially allowing Japanese companies to leapfrog US computer makers.

COMPUTERS
• Japanese vendors will introduce a slew of laptop, notebook and handheld PCs and strengthen their dominance of LCD panels, IC memory cards and batteries.
• Japanese companies will unveil an array of multi-media desktop PCs and interactive video products using video compression and CD-interactive (CD-I) technologies.



COMMUNICATIONS
• Japanese vendors will put faxes into notebook laptop and desktop PCs, paving the way for portable communications.
• Multimedia systems, such as video-mail and interactive graphics, will be introduced on optical fibre networks.

ENVIRONMENT
• Companies will drastically reduce their use of CFCs and other toxic chemicals in manufacturing.
• Less material-intensive packaging and reusable containers will become a lucrative new growth industry.

TRANSPORTATION
• Tokai Railway is beginning construction of a 48-kilometre linear motor car test track this year, with plans for completing the 480-kilometre Tokyo-Osaka line by the late 1990s.

ENERGY
• In the wake of the the Gulf crisis, spending will be increased on alternative energies, such as geothermal, solar, nuclear, biomass and ocean power.

NEW MATERIALS
• New lightweight plastics will be developed for portable computers, consumer products and automobiles.
• Materials requiring fewer toxic chemicals and processing steps will be investigated by manufacturers.

BIO-ELECTRONICS
• Biosensors will be widely used in food processing, petrochemical refining, sanitation systems and other fields.
• Neural networks and fuzzy logic will be used to develop new "intelligent" systems, such as urinalysis toilets, medical diagnosis computer systems and cellular pacemaker monitors.
• Biocommunications, the linking of biosensors to communications systems, will become a major new growth field to the ageing population and interest in portable communications.

THE ENVIRONMENT

Coal power stations? Try algae

A multi-megawatt coal-fired power station emits around 200 tonnes of carbon dioxide every hour. It contributes to steadily rising levels of the gas in the atmosphere. And it increases the risk of global warming through the greenhouse effect.

A Japanese research team is proposing a novel solution – a biosolar reactor based on genetically engineered strains of marine algae that have an exceptional ability to capture carbon dioxide.

Biotechnologists Tadashi Matsunaga and Shigetoh Miyachi have already developed a small prototype reactor around a blue-green alga called Synechococcus, found in shallow water off the coast of southern Japan. Research has shown that the alga thrives in the presence of carbon dioxide levels as high as 20 per cent in air bubbled through the reactor – most algae and plants are adapted to the 0.03 per cent concentration found in natural air, and while they benefit from a small increase, suffer severe inhibition of photosynthesis at higher levels.

Dr Matsunaga, of Tokyo University, has found an ingenious way around the problem of supplying light to the algae in the biosolar reactor. In nature, algae tend to congregate in broad layers to maximise light exposure.

But in a confined volume, a rapid build-up in their concentration turns the water murky green, rapidly attenuating the light before it can diffuse throughout the reactor. So Dr Matsunaga has devised a light reticulating system based on piping sunlight into the brew through a stack of closely-spaced optical fibres that emit light laterally, was well as from their ends.

The Japanese researchers hope to further increase the efficiency of the algae in fixing carbon dioxide by genetic engineering. They also plan to introduce genes into the algae that would cause them to secrete biological compounds into their watery medium, such as amino acids, plant growth hormones and antibiotics.

The catch is that if such biosolar reactors are to work, the carbon must be permanently immobilised – and a big power station would require enormous reactors that would generate huge quantities of algal sludge for disposal. If it broke down rapidly, the carbon dioxide would simply be released back into the atmosphere.

So the team is looking around tropical coral reefs, including Australia's Great Barrier Reef, for species of algae that would convert the carbon dioxide into calcium carbonate – limestone – that could be safely sequestered in the depths of the ocean, or used to manufacture cement.

GRAEME O'NEILL

Michael Pickford, one of the organisers of the Great Australian Science Show.

It's the Great Australian Science Show

The Great Australian Science Show — that's the imposing title of a new science exhibition to be staged in Melbourne in July. Its organisers are Michael Pickford and Simon Monk of the Australian Science Network.

To be held at Melbourne's World Congress Centre, the show will feature the latest significant developments in Australian science, technology and product development. The prime objective of the exhibition, according to the organisers, is to raise the general profile of Australian science and install it as a substantial feature of the national culture.

"Our national heritage has always celebrated action rather than thought," says Simon Monk, who comes from the entertainment industry where he has worked as a manager and promoter. "We inherited a healthy distrust of all intellectual exertion, particularly when it impeded sheep shearing or mineral fossicking which have been the mainstays of our prosperity."

But the problem, according to the ASN, has often been with scientists themselves, who prefer the distance of the laboratory and "technispeak" to genuine public communication and social responsibility. The show is designed as an opportunity to remove some of that distance.

The show will feature a wide range of themes — marine biology, aerospace technology, health and human behaviour, cosmology, industrial engineering and design, the global and domestic environment, telecommunications and information technology.

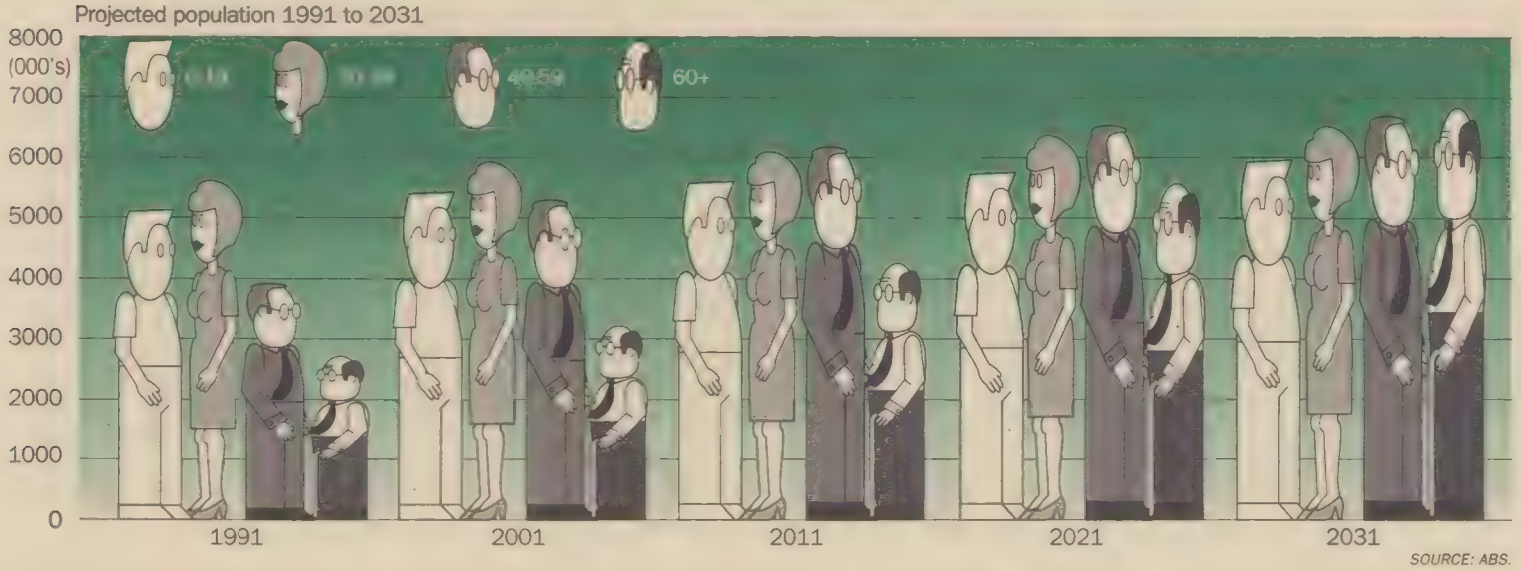
It will also include a program of lectures from many of Australia's leading scientists and science communicators, plus a schedule of demonstrations and live performances. Science-based art, theatre and music will also be presented, reinforcing the concept of science as a genuine cultural activity.

> **"We want our audiences to come away from the show feeling both enlightened and exhilarated"**

"We want our audiences to come away from the show feeling both enlightened and exhilarated," says Michael Pickford, a science graduate who has taught at secondary and tertiary level and has subsequently worked in private enterprise. "The show is all about optimism. We want to share the very important contribution Australian science and Australian scientists are already making to our nation. We hope that our audiences will embrace the experience, committing themselves to our national development through science."

AUSTRALIA'S CHANGING POPULATION

Projected population 1991 to 2031



NORMAN ROBINSON

SOURCE: ABS.

Hi-tech sculpture at the cutting edge

Rob Knottenbelt is a leading contemporary Australian glass artist living near Melbourne who works as a classical hot glass artist but also is a pioneer in the utilisation of CAD-CAM and HP water jet cutters to create glass sculptures.

In 1987 Knottenbelt won the major prize for his first water jet artwork in the 'Glass in Public Spaces' competition staged at the Westpac Gallery, Victorian Arts Centre. Since then his sculptures have been shown in Australia, Germany, Netherlands and France.

He utilises the technology to cut intricate sections out of plateglass. These are assembled creating a balance of positive and negative spaces through and over which light plays, achieving further dimensional qualities with reflections and shadows.

In July 1990, as a short-term Artist in Residency at the Advanced Technology Education Centre in the Regency College of TAFE, South Australia, he was taught how to use highend software to allow him to control the programming required for his sculptures.

Rob Knottenbelt is one of a small but growing group of Australian artists working comfortably with high technology to produce their artworks. In Knottenbelt's case much of what he is exploring may be translated in the future into the broader domestic and international market place.

TERENCE BOGUE

"Mantis" by Rob Knottenbelt, 1990

Superfast transistor is a chip off the old china

The new class of ceramic superconductors discovered in 1987 seem to have faded from the front pages, mainly because it has proved very difficult to make working devices from them.

Being brittle and non-ductile, they are difficult to shape, and defects in their crystalline structure impair their capacity to carry usefully high electric currents.

But these problems are being solved, and the first small-scale working devices are beginning to emerge. Potentially one of the most significant is a new type of transistor that operates several orders of magnitude faster than any in the world today – with no resistance to the flow of electrons, it has the potential to perform a hundred billion operations a second.

The new transistor, developed by researchers Sandia Research Laboratories and the University of Wisconsin, is called a superconducting flux flow transistor (SFFT), and is fabricated from the ceramic that holds the record for the highest superconducting transition temperature. Thallium calcium barium oxide begins to exhibit superconducting behaviour at a temperature of 125 degrees above absolute zero.

The SFFT actually makes clever use of a phenomenon that has frustrated the development of other superconducting devices – magnetic flux creep. If superconducting devices are exposed to strong magnetic fields, the invisible lines of magnetic force that emerge from and loop through space around them, begin to shift, creating electrical resistance that destroys the material's superconducting behaviour. Most superconducting devices will depend on researchers' ability to keep these magnetic flux lines pinned in place.

But the new SSFT, described in the February edition of *Scientific American*, relies on the rapid pinning and unpinning of the flux lines by an applied magnetic field, causing the transistor to shift rapidly between a superconducting and non-superconducting state. This phenomenon allows individual electrons to be switched through the device very accurately and rapidly.

Sandia researchers have already produced chips with several SSFTs laid down as thin films deposited on their surface, forming ultra-small circuits. They believe the technology, which could be in commercial use in just a few years, could shrink microwave circuits occupying an area of several hundred square centimetres into single chips just a few square centimetres in area.

GRAEME O'NEILL

WHOSE FUTURE?

Dust storm over Melbourne – a rare and dramatic reminder of the fragility of our environment

Contour ploughing – ecologically sustainable resource management

PICTURES COURTESY OF DEPARTMENT OF CONSERVATION (VIC)

YOURS...AND MINE

Sustainable development has been identified as development which "meets the needs of the present without compromising the ability of future generations to meet their own needs."

("Our Common Future", the report of the World Commission on Environment and Development, generally known as the Brundtland Report)

The Commonwealth Government, in its discussion paper, "Ecologically Sustainable Development", June 1990, (available through AGPS) took that definition one step further with the recognition that; "economic growth and a well managed environment are fundamentally linked."

Today something exciting and challenging is taking place in Australia.

Nine industry working groups are examining ecologically sustainable development, or ESD. Agriculture, fisheries, forest use, energy production, energy use, manufacturing, mining, transport and tourism have been identified as the main industry sectors that use or have a significant impact on natural resources. Membership of the groups has been drawn from industry, state and federal government, unions, consumer, social welfare and conservation organisations.

Under the chairmanship of Stuart Harris, (Professor, International Relations, Research School of Pacific Studies, ANU), David Throsby, (Professor, Economics, Macquarie University), and Roy Green, (Director, CSIRO Institute of Natural Resources and Environment), the Working Groups task will be to provide advice to Government on future policy directions, and to develop practical proposals for implementing them, keeping in mind four fundamental principles:–

- ***the improvement of individual and community well-being in such a way that will not jeopardise the welfare of future generations***
- ***equity within and between generations***
- ***the global dimension of ecologically sustainable development***
- ***the protection of bio-diversity and the maintenance of ecological processes and systems***

"Fine", I hear you say – but what's it got to do with me?

Answer: EVERYTHING.

Governments and working groups cannot do it alone. Community involvement is vital to the process of change. If there is to be ecologically sustainable development there must be general recognition of the costs involved for us all – and a willingness to change.

Think of it this way. Any natural resource is like having money in the bank. As any good financial adviser will tell you, that money (asset) should be nurtured, invested wisely, husbanded. Because if it's not you will find yourself living off that capital and before long the nest egg will have vanished.

The pollution of Sydney's famous beaches is a graphic illustration. For years sewage was pumped out to sea. Then beaches had to be closed. Businesses began to suffer. "Something had to be done."

In the end the cost of solving that problem was something the whole community had to bear – it has become a community responsibility.

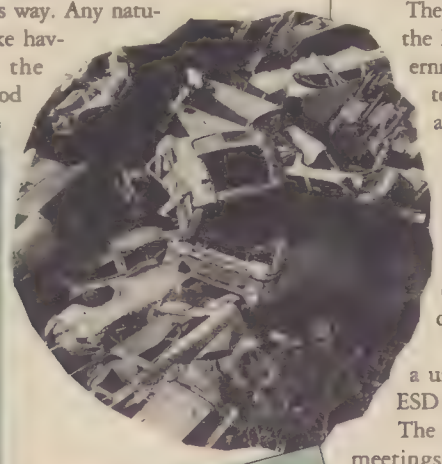
There will be many more beach-heads to tackle.

The involvement of the community is vital to the ESD debate. The Commonwealth Government has recognised this by undertaking to hold community consultation forums around Australia.

Bio-diversity, population, public health, equity of access to services and resources, safeguarding what we have for our children and future generations, global climate change – these are some of the issues which impinge on ecologically sustainable development.

Through the consultations you will have a unique opportunity to contribute to the ESD decision making process.

The ESD Chairmen will be holding twelve meetings around Australia in capital cities and regional centres. A newsletter, **ESD NEWSBRIEF** will provide information about when and where the meeting will be held near you. **ESD NEWSBRIEF** will also keep you up to date with the progress of the Working Groups .



If you would like to receive **ESD NEWSBRIEF**, write to:

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ESD SECRETARIAT
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KINGSTON ACT 2604.

PHONE (06) 272 4183 or fax (06) 272 3448

The Science of Politics

The way the federal government, guided by Environment Minister Ros Kelly, tackled the limiting of greenhouse gas emissions was indeed characteristic of a "mature" and "sensible" nation, as many editorials remarked at the time. We opted to achieve a 20 per cent reduction by 2005, unlike the US which is still dithering, and the UK which is floundering badly, despite Margaret Thatcher's deep understanding of the issues.

Is it too much to claim that our own Greenhouse 88 campaign played a significant part in preparing the nation for this far-reaching decision? I think not. For a whole year the CFF presented the scientific findings, the range of opinion in climatology, the time-span available during which our different professions and communities could come to terms with a likely upheaval — there was rational discussion throughout Australia. This, by the way, is precisely what the Commission For The Future is for.

The result has been, so far, commonsense. There has also been widespread awareness of the issue — unlike some countries I could mention, which remain infuriatingly oblivious. This despite the efforts of certain political dinosaurs who insist on writing in the national press in Australia about some sort of greenhouse conspiracy.

There is uncertainty. There always is about science. That's the whole point. No scientist of any standing will claim to be privy to absolute truth. The very concept is unscientific. But all the scientists I've talked to are convinced that greenhouse changes are a worry. And they are fed up with their professional integrity being attacked by some hack from the twilight zone of politics who manipulates the information as if the research itself is in disarray.

Greenhouse may turn out to be more benign than we now think. At present all the evidence points the other way. We would be stupid to ignore it.

ROBYN WILLIAMS

Meanwhile, the kids strike back. In one month, late last year, I attended four prizegivings for young Australians achieving brilliantly in science.

They included the Earthworm Awards (sponsored by the Federal Department of Education, Education and Training (DEET), ABC and the Australian Museum), the Westpac Maths competition, the Science Olympiads (again DEET) and the Big Break awards (Nescafe). This last was for creative enterprise in all fields, but included science.

Like many of my extreme age, I am impressed beyond words by the fresh, bright brilliance of our youngsters. I'm also exasperated by the mixed messages they seem to be getting about a future for them in science.

On the one hand they see cabinet ministers (John Dawkins, Ros Kelly), governors and governors general standing before them representing a real commitment from the highest in the land to Australia's scientific future.

On the other hand they see little to encourage them to take science as part of their own career options.

May I make some suggestions?

OK, industry is being dreadfully slow in expanding its scientific strength. Trade unions are just as bad. But the change must come in the mid-nineties. As Barry Jones has banged home repeatedly in *Sleepers Wake* (both editions): the jobs of the future will have a huge dependence on science and technology. And, as everyone keeps saying, "half the jobs of the 21st century haven't even been invented yet."

"Scientists are fed up with their professional integrity being attacked by some hack from the twilight zone of politics who manipulates the information as if the research itself is in disarray"

So the best preparation a young Australian can opt for is breadth, including science. At first glance that's the very combination that would make you seem, in 1991, to be unemployable. But that's what I thought of my own grounding back in the sixties and seventies. It's given me almost unlimited flexibility.

When a youngster comes to see me today looking for work, the last thing I want to hear about is overspecialisation. The world is packed with narrow little snots who don't read books. If they haven't done some science I regard them as somewhat crippled.

But as the world changes with bewildering speed, we want broad minds that can be turned to anything; people who can point to places on a map, speak a few languages, tell a quark from a quango. Today's scientist may not be Indiana Jones — the pace hasn't reached that point just yet — but it's far more like Jones than the doddery dork portrayed in media misrepresentations of scientists. Besides, Jones is increasingly likely to be female.

An automobile called Sunny

Discussions in Darwin among entrants in the 1990 Solar Challenge car race, in the days before the official starter announced "Gentlemen start your solar panels" were given added focus by events in the Gulf. Could the exotic shapes taking part in the world's quietest car race, able to cover the 3,000-kilometre race in just 48 hours of mainly overcast weather, also take you and a friend off to a supermarket and bring home the groceries?

"Right now solar-powered cars do not look likely if you speak to most race competitors," answers Dr Michael Seal, Director of Vehicle Development Centre, Western Washington University, a softly spoken rotund figure in his fifties, who designed the radical Viking XX two seater. He adds "I'm inclined to think it is much closer. "

His view is the one accepted by most of the world's solar car experts gathered in Darwin like Germany's three time World Solar Racing Car Champion Michael Trykowski and Dr Fredy Sidler, Dean of the University of Biel whose entry won the 1990 Challenge. They believe that rising fuel prices and environmental concerns will force us away from petrol to electric cars some of which will exploit solar power in varying degrees.

The disagreement is on the degree.

"If a solar car sits for ten times as long as it runs you could produce 15 horse power – which would be sufficient. But it would not be practical for all purposes" explains Michael Seal. "So, I think it would need to be a hybrid with a small clean internal combustion engine producing 50 kilometres per litre, which we have already achieved, driving the rear wheels and a solar-powered electric engine driving the front wheels. So it could be a four wheel drive when you needed it."

Trykowski produces a $14,000 electric conversion kit for East Germany's Tranabt, the tiny three cylinder two stroke which produces blue smoke clouds which blind speeding BMW drivers on unified Germany's autobahns. The exhaust gas-free Trabis combine a range of 100 kilometres with a top speed of 85 kph. He is working on bettering battery life – the weak point of electric cars. His are good for only 10,000 to 20,000 kilometres. Swiss watch-makers, Swatch, have commissioned Dr Sidler, director of the Engineering Support at Biel University, to develop a series of two seat electric car prototypes with large boots within three years. The cars will go into production two years later.

Howard Wilson, the guiding force behind the winner of the last Solar Challenge, General Motors' Sunraycer, delivers opinions based on intensive study which led to the Impact demonstrator, an electric sub-compact complete with air conditioning and car-stereo which can do zero to 100 in around six seconds and designed to hook up to cheap off-peak power – soon to go on the US market.

The genial bald veteran engineer bluntly explained: "There will be no solar cars until there is a greater fuel shortage. And then the energy will come from solar panels on garage roofs, outdoor collectors and so on."

Dr Stuart Wenham, who along with Professor Martin Green is the co-inventor of the innovative laser-grooved solar cells used on the University of Biel's winning entry, is more optimistic.

"Right now on a normal Sydney sunny day you would need eight square metres of our cells to give a car like Impact a hundred kilometre range," says Wenham. "If our cells were mass produced the cost of eight square metres would come down to $10,000. Eight square metres would provide 70 per cent of this car's energy needs over a full year."

The cells, developed at the University of NSW's electrical engineering department, feature deep metal-coated vertical grooves that collect electricity off the top of the cell and deep in the cell as sun reflects off the metal walls. They have an efficiency of 20 per cent, about four per cent better than satellite quality monocrystalline cells, and a potential theoretical 30 per cent efficiency.

"We believe we can get this up to about 25 per cent commercially," predicts Wenham. "Cell prices have come down by a factor of 3-4 over the past ten years.

"We believe they will drop by a further factor of four over the next 15 years. As this happens people will start to put cells on car and garage roofs. I do think solar power has the potential to compete with oil and coal power stations and the internal combustion engine."

JIM BEATSON

PEOPLE

Hello Greenhouse, goodbye kangaroo

John Topping, president of Climate Institute, talks to NEXT

One of Australia's few growth industries for the future, tourism, could suffer badly as a result of the greenhouse effect, according to the president of the Climate Institute in Washington D.C., John Topping.

Topping was in Australia, along with Dr Noel Brown of the United Nations Environment Programme, as a keynote speaker during "Greenhouse Action for the Nineties", a series of conferences and public meetings organised by Greenhouse Action Australia.

When asked what he considered were the chief implications of greenhouse for Australia, he replied: "My feeling is probably the most fragile aspect of Australia would be the ecosystems. You have developed a very unique ecosystem as a result of the 'contintentality' of Australia, where many animals of various species have developed here, essentially protected by the isolation of the country. They've existed within a number of years in a relatively stable climatic regime and if we are to see the kind of rapid change that's being predicted by climate models, happening over a period of a century or less, I suspect there would be very major changes in the habitats of a variety of the various species."

The consequences of this would be a loss of these species, at least in the wild. "When you start to lose the vegetative habitat, you lose animal life that's associated with it, certain birds might also be threatened. My sense from the viewpoint of Australia is the ecosystem, which I think is very much a part of the way of life in Australia, also plays an important part in the economy.

"Australia has a very large tourist-based economy at this point and much of the reason people come here is because of the unique wildlife and other things which are associated with it, so I think that it has economic consequences, as well as being very important to the national character of the country."

If Australians think this will only happen in our more arid areas and our highly populated areas around the coast will be fine, Topping disagrees.

"Patterns are going to shift. There's going to be some disruption, most areas will tend to get hotter, but it won't be evenly distributed. I think the very fact of this happening quickly creates a shock to the system.

"The kind of change which might be accommodated very readily over 500 years, happening over 50 years, may be very devastating."

As to what could be done about this, John Topping puts forward an interesting scenario. He says: "The rate of change will be much faster than nature's ability to adapt. So what it essentially does is force the situation where man will be actively forced to intervene. In order to preserve the environment, we're going to have to intervene in a massive way.

"Traditionally, we've tried to manage a lot of environmental problems by letting nature take its course, but what happens essentially here is that we've set things so out of kilter as the result of the rapid climate change caused by human actions, that you're then forced, in effect, to 'play God' again to counter other human actions that have set this in motion and this is not a very comfortable situation to be in."

"We've set things so out of kilter as the result of the rapid climate change that we're forced to 'play God' again to counter the human actions that have set this in motion"

Topping predicts that the preservation of many species will depend on a very aggressive policy of moving animals and relocating them, moving receding trees, moving vegetation in certain ways, moving animals to some areas where they may remain comfortable for a generation or so and then moving them again. He warns that although the species might be preserved in this way, "what you're going to lose is the depth of the species. You may be able to preserve a species itself so you don't have total extinction, but there's a big difference."

Something else Australia has to be concerned with, along with the United States, is a massive influx of environmental refugees fleeing these radical climatic changes, many of whom will come from Pacific countries and South East Asia.

"As these people are forced to flee, obviously those countries which are perceived as having a fair amount of land would be expected to take a number of refugees far in excess of what would normally be the case," he said. He suggested that a lot of these considerations come together to give Australia good reason to take the fairly strong stance that it has in the international forums and gives the Australian public good reason to look at practical ways of trying to implement the government's goal of not only trying to control greenhouse emissions but perhaps cut carbon dioxide and certain other emissions by 20 per cent.

"At this point," he said, "they have to find out how to implement it. You have a very strong officially stated policy, now you start moving from what are fairly ambitious targets, to actual, practical steps. Like decisions made by governments, corporations, individuals and others.

The crunch right now is to actually have our actions match our policies and it's not easy for any country to accomplish that."

The Climate Institute, of which John Topping is the president, has, as one of its chief concerns, providing governments with information on which to base major decisions.

The Institute is now international and is made up of climate effect scholars, people studying the impacts of climate change and current and former environmental officials. Its role is described as "acting as a bridge between the scientific community and the policy community", trying to translate the "Scientese" into much more understandable terms, particularly by policymakers and planners who will be making key decisions on this issue.

Asked whether the information was always acted on or whether it was simply ignored if it was economically pragmatic to do so, John Topping gave the example of an Institute meeting with the President of Mexico. This occurred several days after Mexico had experienced an episode of air pollution which was the third worst in its history. He said: "Shortly after the meeting, the President closed a very major oil refinery in the city, temporarily sacrificing substantial production but acting very much for human health reasons."

The President then asked the Institute to prepare a contingency plan which could deal with future emergencies and at the same time, deal with the problem that when this happens, a large number of manufacturing industries automatically close, regardless of their effect on the environment. The institute's plan would take into account the performance of each industry so that economic activity could continue, as well as protecting human health.

"In this case," said Topping, "the Institute considers the government of Mexico was very responsible in its actions. Politicians face scientific uncertainty all the time and they have to have the courage to act. Here we had a government leader who was willing to make very tough choices."

He was quick to dismiss claims that the possible impact of the greenhouse effect has been greatly exaggerated, saying: "Some of these theories have had substantial coverage in the US press and there is a tendency sometimes for the press to simply get two views, one to balance against the other, no matter what.

"There are some legitimate scientists in the debate who are saying that, while we've seen a warming to date, it isn't necessarily indicative of greenhouse effect, it may be essentially a far swing with a natural variability.

"But I don't think there are many legitimate scientists about who are in the position of arguing that we're not going to see some significant change, if the build-up of greenhouse gases continues. There is a real debate in the scientific community as to how severe this change might be. But even if you look at the low end of the spectrum, you're still talking about quite significant change by any standards which humanity has historically experienced.

"If you talk in the middle range of the scale, you're talking about a very large and potentially disruptive change and I think there's just as much chance that you may find something at the higher end of the scale. In fact, if you look at the uncertainties, there probably are more of the uncertainties that tend to be on a higher side.

"For example, the recent 'Inter-Governmental Panel on Climate Change' report essentially indicated, after making its projections, that if anything, they were a little bit conservative, because there were more of what the scientists call 'positive' feedbacks than 'negative' feedbacks.

"That is, the warming itself causes certain other changes in the system, some of which amplify and some of which may reduce the rate of warming. But the 'positive' feedbacks, those that add to it in fact, tend to outweigh the negative feedbacks and it's likelier that the rates of warming will be a little bit higher."

MURIEL COOPER

DAVID JOHNS

The koala threatened with extinction? In the Greenhouse scenario an aggresive policy of moving animals and their habitats may be needed to save them.

Australia's new threat: our suburbs

Brian Howe, Minister for Community Services and Health, has taken a strong view on the future development of our urban environments. In this extract from a speech given in April, he lays the blame on the motor car:

"We have a major problem with the way we use private motor vehicles. Is scarce capital best spent upgrading and extending arterial roads at the expense of investing in more efficient, cheaper and environmentally less damaging modes of public transport?

In 1891, Sydney was a city of 382,000 people who mostly lived within a mile or so of the ridge which runs between Circular Quay and the railway terminus. People lived close by their work and commonly walked to and from work each day.

Tramway construction opened up Sydney's suburbs to settlement. This opened up land that was cheaper than that close by the city and those who could save from regular wages could build their homes on land they owned. This is still the model of urban development we are pursuing.

During the 1980s our population grew by an average of a quarter of a million people a year – the equivalent of adding a city almost as large as Canberra each year. Most of this increase has been occuring at the fringes of our capital cities. Continued growth on the urban fringe results in pressures on infrastructure development and much higher costs in servicing this land.

Poorly planned growth at the fringes of our cities is not only unsustainable in terms of cost, but inefficient and inequitable as well. Those who move out to these fringe areas go there because appropriate and affordable housing is not available closer to the services and employment opportunities they need.

The challenge is to shape cities and other urban areas in ways which ensure more efficient travel between home and work and to provide the services people need in locations which support the links between home and work.

Suburbs are now an environmental threat because we have chosen to make our primary form of transport private motor cars. To address this, we must pay as much attention to the problems of our urban environment as we do to the forests."

The Pacific fibre-optic revolution

The seas of Asia are being wired, reports Michael Westlake of The Far Eastern Economic Review

The development of fibre-optic cable technology is leading to a resurgence in the usefulness of submarine cables and a shift away from a reliance on sateliite links for certain types of data transmission. With international telecommunications traffic growing at up to 25 per cent a year in parts of Asia, submarine cable and satellite capacity is being added at a huge rate to cope with the flow of data among banks, stockbroking houses and airlines, as well as a surge in voice traffic.

Satellites are ideal for multi-destination traffic, and are also used heavily for point-to-point signals over long distances, such as from Hong Kong to Europe. But as more countries in Asia switch to digital telecommunications technology, fibre optic cables offer greater capacity and faster response over short-to-medium distances and even for long routes across the Pacific for high-speed data.

There are 15 cable systems either being implemented or planned for the Asia-Pacific region. When all have come to fruition, various groupings of telecommunications authorities and private companies will have spent about US$3.5 billion on fibre optic cables beneath the sea between 1989 and 1995.

Some of the existing, analogue-system copper-wire cables will be salvaged for their scrap value. But many will be left in place to add to reserve capacity in case of breakdowns.

Fibre-optic cables typically can carry more than 30 times the amount of traffic sustained by the older type. As a result, the new technology's unit cost per circuit is lower. This should enable tariffs to be lowered in time, attracting still more business. Of the 15 systems, nine cross-sections of the Pacific or the Tasman link Australia, New Zealand, the US, Canada, Guam, Japan, Taiwan and the Philippines. Three of them involve Guam as a connecting hub, while four use Hawaii (including one which uses both places). Four are already in use. The total cost of these nine systems is estimated at US$2.6 billion.

Another long cable, Sea-Me-We 2, will connect Singapore and Jakarta in South East Asia with the Middle East and Western Europe by 1994. Two other Asia-Europe cables are also being considered because of fears that a trans-Siberian fibre link may not happen because of problems in the Soviet Union.

NORMAN ROBINSON

OPTICAL FIBRE SUBMARINE CABLE NETWORK IN ASIA

Of the rest, two already link Hong Kong with Japan, South Korea and Taiwan, with a Hong Kong-Philippines cable due to enter service in mid-1993. But the most complex of the systems in Asia will be the Aspac link connecting Malaysia, Singapore, Hongkong, Taiwan and Japan. Costing US$310 million, the system is due to enter service in mid-1993. There is also an Asean system being set up in stages at a cost of US$320 million, with completion of all links connecting the grouping's six member states due in early 1993.

Ownership of these cable systems varies, with different groups putting up money in return for capacity that they can then either use themselves as carriers or sell or lease off to other organisations. Usually, members of the group comprise the telecommunications operator at each end of the link, plus other operators or high-volume corporate users which need transit capacity along the particular cable's route.

There is no fixed rate of return for investment in any one cable, but each company makes its own private calculation. Major factors are a design life of 25 years and time-to-cost-recovery of at least 10 years.

Some of the consortiums being formed are extremely complex. The cable linking Hong Kong, Japan and South Korea that came on line last year involves 27 partners, while the cable connecting Guam, the Philippines and Taiwan, operational since 1989, has 23 participating companies.

As the governments of the US and Europe have increasingly liberalised telecommunications policy, the traditional operators who had clubbed together to set up cables have been forced to become more aggressive in competing with new entrants, particularly by boosting capacity. The prize sought by the partners is operation of hubbing centres in various parts of the world, picking up fees for transit traffic where it passes through shore equipment and having enough extra capacity to lease or sell it for big profits to other operators.

In that sense, sub-oceanic cable systems are no longer viewed as semi-public utilities. Rather, they are lucrative toll-roads, whose very creation generates more traffic and thus more revenue.

The cables comprise hair-thin glass fibres, along which signals are sent as pulses of laser-generated light. Voice transmissions are broken up into digital "packets" at one end, travel along the fibre via sub-sea booster units to maintain signal strength, and are re-assembled at the destination for the final leg to the recipient's telephone. Data, being digital anyway, is easier to process but travels along the fibre in the same way.

During the past 10 years, optical fibres and the associated equipment have progressed from sending 45 million bits of data per second (Mb/s) to today's figure of 560 Mb/s. Also, bandwidth, the capacity to carry simultaneous signals, has expanded dramatically.

For the past 20 years or so, satellites have been the way to go in terms of adding capacity because of severely limited bandwidth on analogue cables. But in 1989, the first submarine cable went into operation for trans-Atlantic traffic, the same year that the Pacific's first such cable started work.

So successful have these early cables been that there are plans for another nine trans-Atlantic cables by 1995, though the trans-Pacific network is not expected to see such dramatic growth because of widely differing time-zones at each end. Even so, the prospect is for a flood of new capacity in the market in the next few years. The result should be a sharpening of price competition between competing partnerships.

Ultimately, cables may take traffic away from satellites or slow the growth of the standard telecommunications market that satellites have enjoyed until now. But this merely opens up opportunities for satellite operators in such fields as maritime and aeronautical communications and satellite broadcasting. The variety of communications services offered is likely to grow rapidly as operators of all systems seek to occupy capacity to cover their costs, with the result that consumers should benefit from falling prices.

WHAT'S NEW

➢ Pay telephones could soon offer some of the same sophisticated services that are coming to private and office phones. These services include voice messaging, where a caller who recieves a busy signal can record a message. And computer-enhanced pay phones, which will have an internal microcomputer to allow users to make airline reservations or scan the news, are also on the way.

➢ **The latest device on the streets of New York: ECHO (Emergency Call Help Out). A walkie-talkie shaped device, designed to be worn or carried, it acts like a car-alarm for the body. When threatened or attacked, the carrier pushes a button or pulls a rip cord to activate a shrill, piercing siren.**

➢ Another new security device on the US market: a car security system that tracks a stolen car by satellite. People in the central tracking station can communicate with the thief to inform him that the vehicle is being tracked and advise him to abandon the theft.

➢ **The Paris metro of the year 2000 is in sight — a 150-foot [46 metre] long continuous tube known as the "Boa". Because the train is not sectioned off into carriages, up to 890 passengers will be able to walk from one end of the Boa to the other. With its swivelling axles the train will be able to negotiate curves smoothly and noiselessly.**

➢ A Swedish engineer has invented a non-pneumatic composite wheel for cars. Hans Erik Hansson's wheel, which emits far less noise than conventional tyres, is made of composite materials in a single self-supporting unit onto which a rubber tread is glued.

➢ **A lawn-mowing robot has hit the US market. The cutely-named Lawn Ranger cuts 25-inch swathes of grass as it travels in ever-smaller circles around a yard. When it finishes at the centre, it automatically shuts off.**

➢ A unique two-volume Encyclopaedia of the Future will be published in 1992. Some 300 prominent futurists will contribute to the work, which will summarise and integrate current scenarios about the future, as well as studies on a variety of trends affecting society. The encyclopaedia will be published by the Macmillan Publishing Company in the US.

➢ **Panasonic has launched a "smart" car stereo onto the US market which can find the radio station that suits its owner's musical tastes. Once the musical preference is programmed (classical, rock, jazz, etc.), the radio will find the right station, searching constantly even when the car drives beyond a particular station's range.**

➢ The latest Porsche technology combines the thrill of a manual gear-stick with the convenience of an automatic. The new four-speed Tiptronic transmission either selects its own gears or can be manually shifted without a clutch.

➢ **It's the world's biggest facsimile machine — according to no less an authority than the Guinness Book of Records. The WideFa, machine can transmit images up to 61cm wide, compared with 21.5cm for regular-sized machines. It is especially useful for sending images of blueprints and engineering documents. What's more, it is portable enough to carry to building sites for faxing plans back to head office. It's price in the US: around US$14,000.**

➢ Waiter, take my order. A new device from NCR adds considerable meaning to those words by restaurant patrons. The hand-held entry unit enables the waiter to tap in customers' orders at the table. They are then transmitted to the kitchen.

Starting in September, American students will be able to obtain a tertiary degree via television. The University of Maryland will be the first college in the US to offer a bachelor's degree via cable television — although students will have to leave their living rooms to sit their final examinations.

HINDSIGHT

A regular section looking at past predictions of the future

In 1878, Thomas Edison predicted ten future uses for the phonograph, which he had just invented. Here is his list, along with the medium that made most use of his idea:

1. Letter-writing and all kinds of dictation without the aid of a stenographer.
• The dictaphone was first used for this purpose, followed by the mini-cassette recorder.

2. Phonographic books, which will speak to blind people without effort on their part.
• The LP has been used for recordings for the blind, but this area greatly expanded with the cassette tape.

3. The teaching of elocution.
• The tape recorder made this widespread.

4. Reproduction of music.
• Here, Edison hit the bulls-eye. Music reproduction is by far the most popular use for LPs, tape cassettes, and now compact discs.

5. The "family record" – a registry of sayings, reminiscences, etc. by members of a family in their own voices, and of the last words of dying persons.
• The audio-cassette recorder and more recently the video-cassette recorder, has made this popular.

6. Music boxes and toys.
• Although there are toys that "speak" to children, the music box is one prediction of Edison's that has never really made it big.

7. Clocks that announce in articulate speech the time for going home, going to meals, etc.
• Alarm clocks that can wake you up with a recorded message have only recently been developed.

8. The preservation of languages by exact reproduction of the manner of pronouncing.
• Records, wire recorders, and cassette recorders have all been used for this purpose.

9. Educational purposes, such as spelling and other lessons, and preserving teachers' explanations.
• Although not in exactly the manner Edison envisioned, audio and videotapes are now being used for education, in and out of schools.

10. Connection with the telephone, so as to make that instrument an auxiliary in the transmission of permanent and invaluable records, instead of being the recipient of momentary and fleeting communications.
• Although telephone lines are used for transmission of broadcast and personal material, the answering machine is probably the most popular consumer use of the recorder in relation to the telephone.

Thomas Edison contributed much to the world of electricity and recording, and it all started with the words, "Mary had a little lamb...", recorded on a cylinder covered with tin foil.

CSIRO enters the digital classroom

Medical students of the 21st century could perform their first operations on video disc, in much the same way that pilots learn to fly sophisticated aircraft in simulators. This is a possible outcome of a new development by the CSIRO into the the field of hi-tech education and learning.

CSIRO has reached agreement with Film Australia and computer giants Apple and Digital Equipment Corporation to jointly establish a facility where computer-based education systems can be researched and developed. The project, known as the Centre for New Technologies for Education and Communication, combines all the new technologies applicable to education. These mainly concern lasers, video and computers and include interactive video discs, CD ROM, computer-generated graphics and learning shells, which are softwares that allow the user to interact with the computer and control the learning process.

The project is the culmination of some deep thinking by CSIRO staff on how to best facilitate access to its enormous data base, and how to play a role in integrating new digital technologies with Australia's education needs. The main objective is to develop computer-based systems that allow people to educate and skill themselves at their own speed, in their own way.

"New technologies are going to change the way people are educated in this country, and CSIRO is the ideal body to coordinate this change," says Dr Ray Haynes, a research scientist in CSIRO's Institute of Information Sciences and Engineering.

"We need to develop better human interfaces with the new technology. Essentially, computer companies produce and sell black boxes which people then have to learn to use. We need friendlier ways to interact. We also hope to develop new ways for people to navigate their way through very complicated data bases."

CSIRO

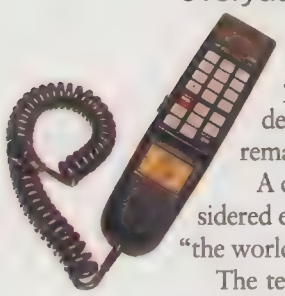
LIFESPAN

The Telephone

FROM BELL TO CELLULAR

BY PHILIPPA HAWKER

Bell invented it more than a century ago. Today much of the world depends on it. Once it merely transmitted voices, now it sends faxes and pictures as well. The telephone: the first in our new Lifespan series, tracing the history and future of everyday products



"The Palace of Winged Words." That was the description used by one newspaper in 1881 after the opening of Australia's first telephone exchange. It is a description that graphically reveals the perception of the telephone at the time: a remarkable, even miraculous instrument that transformed the power of speech.

A century later, the telephone is part of a telecommunications network that is considered equally remarkable. But today it is described rather differently: it has been called "the world's largest machine".

The telephone's extraordinary progression started with the telegraph, itself a device with the capacity to send messages far more swiftly than had previously been possible. The obvious, exciting innovation of the telephone was that the messages could now be relayed by voice, an aspect that was paramount to its inventor, Alexander Graham Bell, with his long-standing interest in the voice and his commitment to improving resources for the deaf and hard-of-hearing. Where the telegraph was not a means of expression, being neither

personal nor intimate, the telephone provided direct communication, both backwards and forwards. At first, the telephone functioned as a kind of intercom, connecting two fixed points and operating only over short distances. This clearly limited the number of connections a user could have, but in 1878, two years after Bell's momentous invention, the first telephone exchange was set up in the US. This meant only one connection was needed, to the exchange. To speak to someone, the caller simply lifted the telephone receiver and was connected to the exchange. The caller asked for the appropriate number, the operator contacted that person and the two were connected.

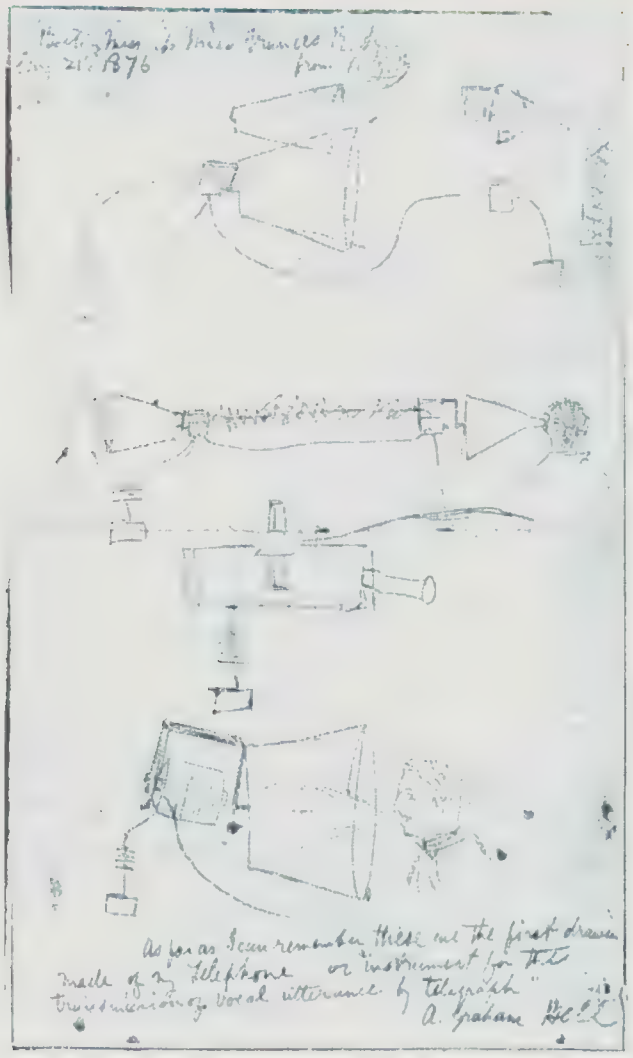
It is impossible to convey the astonishment this new invention aroused at the time. It was simple to use, and it didn't even require reading or writing skills. Early experimenters with the telephone sometimes organised social gatherings around it, setting up conversations from house to house, even transmitting music down the line.

But the main emphasis was on what the telephone could do for business. "This offers a great convenience to business men," commented the *Sydney Morning Herald* on 7 August 1880 on the establishment of Sydney's first telephone exchange. "Nothing settles a matter of business so quickly and satisfactorily as a clear mutual explanation," commented the *Australasian Sketcher* in January 1881.

An early experimenter, Alfred B. Biggs, teacher and amateur astronomer, who is said to have been the first person to use a telephone in Australia, also saw it as an aid to commerce. "This system will bring the entire community of business and professional men together," he said.

This communication between the captains of industry and commerce is made possible by converting sound waves – which do not travel fast or far – to electrical impulses, which do. The telephone user talks into the mouthpiece, which contains a carbon microphone with a diaphragm which vibrates when the user speaks. The vibrations cause the carbon grains in the microphone to compress to varying degrees, and this alters their resistance to an electric current passing through them, which is activated when the receiver is lifted.

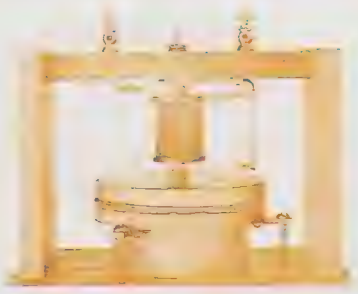
These patterns of electrical vibration duplicate the soundwave vibration. The electrical impulses travel down the line and are then converted back into soundwaves by a diaphragm and an electromagnet in the earpiece at the receiver's end. The variable electrical signals cause the magnetism of the electromagnet to vary, making the diaphragm vibrate and give out soundwaves which duplicate those made by the voice at the other end. The listener hears an exact reproduction of the words spoken into the mouthpiece.



Alexander Graham Bell's first sketches of his 1876 invention, the telephone

1858: Queen Victoria and US President James Buchanan exchange greetings through the first cable to cross the Atlantic.

1866: The first permanently operating Atlantic cable is installed.



A model of Bell's first telephone

1874: Alexander Graham Bell devises a method for sending several telegraph messages along the same line.

1876: Alexander Graham Bell sends the first message by telephone on 10 March.

Born in Edinburgh in 1847, Bell was the third Alexander in a family which had a long-standing interest in the study of sound and speech. His grandfather was an actor and elocution teacher; his father devised a pictorial code called "visible speech" which was used to teach deaf people to speak. As a child, Alexander Graham Bell showed an interest in voice production; he used to manipulate his pet dog's throat to turn its growls into sounds that resembled speech.

Bell taught elocution from the age of 16; in 1865, he started to think about transmitting speech electronically after he read Herman Helmholtz's *The Sensations of Tone*, from which he learned the theories of sound. The family moved to North America, partly for health reasons. Alexander Graham Bell set up a speech training school in Boston. In 1873, he became professor of vocal physiology at Boston University. He married one of his students, a woman who had become deaf in childhood. Her father, a wealthy Boston lawyer, became one of Bell's backers in the many inventions he pursued.

In 1874 he devised a method for sending several telegraph messages along the same line. In 1875, a working model of a diaphragm magneto telephone, based on Bell's design, was built by his assistant, Thomas Watson. In 1876 he was granted a patent for the

More than a century later, in an age of mass media and mass communication, the telephone is still principally seen as a one-on-one device. It is interactive. It enables us to talk to people, to gain access to information, to pass on instructions. We speak to lovers, to family, to friends, to colleagues. We receive obscene phone calls, proposals from telemarketing companies, job offers, gossip, good news, and the worst possible news.

We dial locally, interstate and overseas, and we can transfer calls from desk to desk at the office. We are accustomed to calling for emergency services: the fire brigade, the police or the ambulance service. We might ring for recorded information: from the obvious, like the time and the weather, to less predictable services like Dial-A-Pope, with its daily inspirational message from the Pontiff. In the 1980s, we are used to calling a person and leaving a message on an answering machine.

We are familiar with talkback radio, we can place bets by phone, and in an age where there is a sense of panic about promiscuity, we can make fantasy phone calls.

When we want more general information we turn to the news media: telephones are an integral part of newsgathering and transmission for radio, newspapers and television.

Our day-to-day finances depend on the telephone: automatic teller machines use the phone lines, charge cards use the phone lines for relaying billing information.

The facsimile machine, which has only recently become a part of our lives, allows us to transmit documents from office to office, state to state, immediately: to send messages to people without speaking directly to them; to conduct business across international time zones much more easily. There are those who believe that this virtue has its drawbacks: the immediacy, the 24-hour availability of the fax will make people work harder, but will put them under constant, perhaps unbearable pressure, it is said.

But the telephone has also had an impact in less obvious ways. In 1908, the chief engineer of the US telephone company AT&T suggested that it was not too far-fetched to say that it contributed to the development of the skyscraper. "Suppose there were no telephones and every message had to be carried by a personal messenger. How much room do you think the necessary elevators would leave for offices? Such structures would be an economic impossibility."

The telephone made it possible to build upwards, to concentrate a lot of activity in a small space. But it also made it possible to build outwards: to move people out into the hinterland. It made the central business district possible.

The administration of a factory or a business didn't have to be carried out on site: the managers or owners could be elsewhere. They could congregate in one place, bringing together that community of business and professional men that Alfred B. Biggs spoke of, but more literally than he had imagined.

telephone. He intended to use it to help the deaf.

On 10 March 1876, he was setting up equipment when he accidently spilled battery acid on his trousers. He automatically called out to his assistant, "Mr Watson, come here . . . I want you." Watson was waiting on the other end of the telephone circuit on another floor of the same building, but heard the message, the first to be transmitted by telephone.

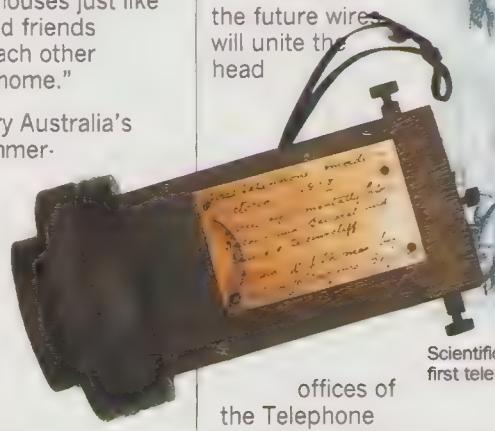
Bell wrote: "This is a great day for me, and I feel I have at last struck the solution of a great problem and the day is coming when telephone wires will be laid into houses just like water or gas, and friends converse with each other without leaving home."

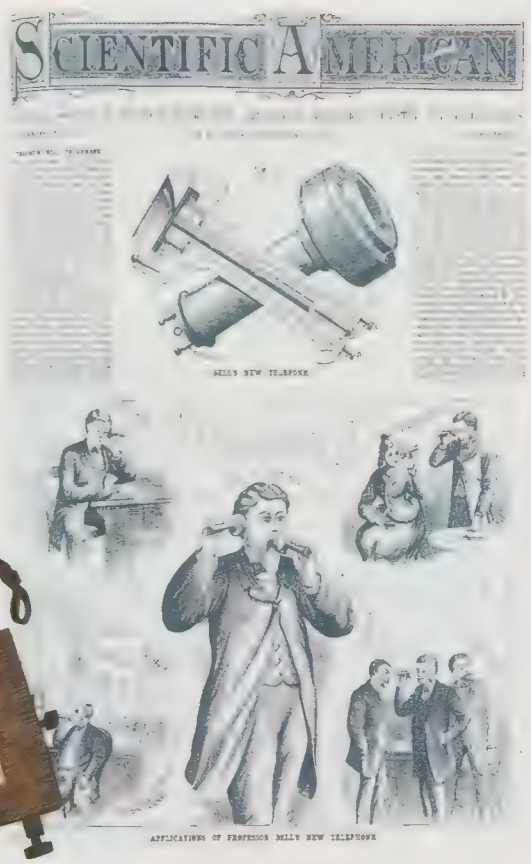
1878: In January Australia's first regular commercial telephone service is established, linking the Elizabeth Street office of hardware importers McLean Bros & Rigg with the Spencer Street store.

Also in January, the first commercial telephone exchange in the world is set up in Connecticut.

W.J.Thomas, an official of the Geelong customs house, who experimented with home-made telephones and linked houses in his area, transmits over longer distances using the telegraph line between Geelong and Melbourne and Geelong and Queenscliff.

"I believe in the future wires will unite the head offices of the Telephone Company in different cities, and a man in one part of the country may communicate by word of mouth with another in a different place," writes Alexander Graham Bell.





Scientific American's 1877 review of Bell's invention, and the first telephone made in Victoria, in 1878

The Victorian Post Office report notes: "The branch establishments of several business places in Melbourne and the suburbs are now connected with their head offices by means of telephones. The great drawback to the utility of these instruments when first introduced was the difficulty of calling the attention of the person desired to be spoken to. This has been overcome by the attachment of signal bells to the wire."

1879: United Kingdom's first telephone exchange is set up in London.

Bell invents the selenium telephone, which uses light rather than electricity. This idea was realised more than a century later when optical fibres, which transmit light between two points, were used for long-distance communications.

1880: In June, the first telephone directory is issued in Melbourne.

In August, Australia's first telephone exchange is opened in Collins Street, Melbourne.

In November, Sydney's first permanent telephone line is installed, linking the Darling Harbour Goods Yard to the Royal Exchange at Bridge Street in the city.

1881: The world's first long-distance line links Boston to Providence.

The *Australasian Sketcher*

It has brought them together in surprising ways, however. It made the building of tier upon tier of offices possible, but it also undermined some of the invisible structures of business. Marshall McLuhan described how traditional authority patterns could be undermined by the swiftness and decisiveness of a phone call. "The pyramidal structure . . . cannot withstand the speed of the telephone to bypass all hierarchical arrangements," he once said.

The telephone disrupted hierarchies and bestowed autonomy, but it also took it away. Diplomacy is one example. According to leading communications theorist Ithiel de Sola Pool: "In those days when an exchange of letters with home could take months, the ruler who sent an ambassador off had to bestow full power on him to negotiate, bargain, compromise and commit his country without checking back . . . Today the ambassador is no farther away than the other end of the telephone, and he does not change a comma in an agreement without first checking."

And similarly the telephone that made it possible for skyscrapers to be built also makes it feasible for people to abandon those buildings, to work from home with a telephone, an answering machine, a fax and a computer. It allows people mobility between home and office or offices, using a cellular phone.

Now, as advances in telephone technology link it more closely with computer, satellite, video and radio, the possibilities for its use become more complex, more exciting, and the consequences more difficult to predict.

We still use it to convey winged words, but the world's largest machine is getting larger still. It is important that users are informed about the technology that is available to them: what it is capable of, how it can be used and abused, who controls it, and what are its implications for the future.

THE FUTURE

In the 1990s we will no longer regard the telephone as an instrument. Instead, we will think of the telephone network and all the things it can achieve. Many of these new services, now being introduced or finalised, will be part of our lives within five years.

The Universal Personal Telecommunications (UPT) system, for example, has been accepted internationally, but can't be introduced until agreements about universal standardisation have been drawn up. The principle of UPT is that individuals, rather than pieces of equipment or addresses, are given a telephone number. The key elements of this system are personalised charging and personal management of incoming and outgoing calls.

Instead of changing phone numbers every time you move house, job or office, your number will accompany you wherever you go – and you will use it anywhere in the telephone network. Instead of having different numbers for the home, office, fax and mobile phone, one number will cover them all. The user simply informs the network which service he or she is on.

The device that makes it possible is a UPT "smart" card, the same size as a credit card. It is possible, in fact, that it could replace credit cards. With a microprocessor embedded in it, the card can also store a wide variety of personal information, including credit and banking details.

Individual users could decide whether they made use of this facility; subscribers might simply prefer to confine their use of the UPT card

LIFESPAN: THE DEVELO

Telephone made in Sydney in 1890

writes of the new Melbourne Telephone Exchange: "Of its utility there can be no two opinions. As an invention which will enable a man sitting in his own office to ask his bank manager for an overdraft, order a coat from his tailor and send his wife any reasonable excuse for his non-appearance at home at the usual hour, deserves a first class certificate in the direction of usefulness."

1882: The development of a wall telephone with built-in writing tablet, fixed generator, separate receiver and hand geneator and battery.

Australia's first country exchange is opened at Maryborough, Queensland.

The Postmaster-General's Department sets up an exchange in Sydney's GPO. For a short time there are two separate exchanges in the city.

1883: Telephone exchanges established in Adelaide, Hobart and Launceston.

1885: Construction begins on the world's first commercial long-distance line between New York and Philadelphia, allowing subscribers to make their first long-distance calls.

1886: The first Australian trunk line between Adelaide and Port Adelaide is opened.

1889: The first payphone is developed in the US.

1890: The Berthon wall telephone, with receiver and large saucer-shaped transmitter, is developed. It has an additional receiver to be used when reception is poor.

Almon Stowger, an undertaker from Kansas City, invents a switching device which bypasses the operators. It is said that he wanted to stop them from listening in. The device was an early switching mechanism which allowed calls to be connected by electrical impulses which triggered mechanical relays one after another. It is said to be the first electro–mechanical system. The formula to determine the number of interconnections is: the number of phones multiplied by that number again, subtract one and then halve the total, ie. for 100 phones, 4,999.5 connections are required, for 10,000 phones, 49,999,999.5.

1891: The first international phone link, between London and Paris, opens.

An early telephone exchange in operation

1892: Alexander Graham Bell makes the first call from New York to Chicago.

The development of the Ericsson handset telephone designed by Lars Magnus Ericsson is completed.

1901: At Federation, 32,767 telephones are in use in Australia.

1907: Almon Stower's switching system, which involved a set of switching keys, is replaced by a circular dial.

Hobart exchange introduces central battery system.

to the telephone and maintain separate cards for banking, credit and other forms of identification.

In the office of the future you may simply arrive at a desk, claim a terminal, pick up the handset, put in your UPT number, and you will be recognised by the network. If you travel overseas you can use your number. Personal charging means that the user, rather than the service, is charged. There are obvious benefits for business and the household; there is a clear record of who has used the phone. Responsibility for payment can be readily assessed.

There will also be ways of controlling cost: a limit can be put on the value of calls that younger members of a household can make, for example.

At this stage, discussions are still underway about the best method of differentiating between business and personal calls, yet retaining the simplicity of a single UPT number. It might be possible, for example, to have two different PIN numbers on a single UPT card.

There will be other benefits of UPT. Subscribers will have much greater of control over the calls they receive. Calls can be screened and instructions given to the network about which calls can be taken. Users will be able to limit incoming callers to a select group, or can ensure they are available 24 hours a day.

The international committee which meets in Geneva to determine the exact nature of UPT will consider issues such as method of registering; how long the UPT number should be; the method of charging; what kinds of information should be available for transfer from one national database to another.

Looking further ahead, it will be possible for trains and planes to become mobile offices, with public computer terminals to which access is gained using UPT. And when terminals are commonplace in the home, it would be possible to have a personalised "newspaper" in which information can be customised to suit the interests of individuals.

Then there are videophones, which will offer telephone users a facility that has the potential to transform the way people speak to each other. For this reason, it is possible that there might be resistance among users who have been accustomed to the degree of privacy provided by voice-only calls.

The idea of an image to accompany a voice message is not new. In 1914, *Scientific American* predicted that a telephone and a "picture-phone" would one day allow people to have business meetings without adding to urban congestion.

But the still-image phones which have been on the market for the past few years are fairly limited, offering only a black-and-white image without voice communciation while the image is being sent.

Video-conferencing technology is more advanced. Groups of people can conduct meetings from separate locations, either by renting a video-conference facility or installing the equipment at a cost of around $120,000.

ENT OF THE TELEPHONE

A 1930s advertisement for the telephone

There is no longer any need for separate batteries at each user's premises.

1910: Alexander Graham Bell visits Australia to advise the Federal Government's Postal Commission.

1911: Australia's first automatic exchange is installed at the GPO in Sydney, for internal use only. At this stage there are 100,000 telephones in use in Australia

1912: The first automatic exchange for public use is opened July in Geelong, with 800 subscribers. It is the first in the Southern Hemisphere, and the second in the world.

The first payphone is introduced in Australia, an automatic electric phone with a cast-iron coin box

1915: Alexander Graham Bell takes part in the opening of the first transcontinental phone line in the US. Once again, he says to his assistant: "Mr Watson, come here . . . I want you," but this time Watson is on the West coast, and Bell on the East.

Several technical improvements had made long-distance calls possible. These included the invention of the loading coil, which meant that the diameter of the copper wire carrying the signal could be halved. Another key improvement was the vacuum tube, which made it possible for the signal to be received and transmitted much more loudly and clearly.

1921: The dial pedestal telephone is introduced.

1930: The first overseas calls from Australia become possible, with the introduction of a radio-telephone service to England.

1932: Plastic handset telephone comes into use.
1936: Calls to Tasmania from mainland Australia are possible.

1948: The world's first telethon takes place in the US – a televised fundraising event in which viewers call up the show to pledge donations. Milton Berle, the entertainer known as "Mr Television" worked 24 hours straight, raising $100.000 for the Damon Runyan Memorial Cancer Fund. In 1956, Jerry Lewis inaugurates his famous Muscular Dystrophy Association telethons, which raise tens of millions of dollars every year.

The release of Sorry Wrong Number, starring Barbara Stanwyck, in which a neurotic and wealthy bedridden woman overhears a murder plot on a crossed line. Stanwyck spends most of the film on the phone, looking for help and trying to find her husband's whereabouts before she realises that she is the intended victim.

1950: Australia has 700,000 telephone subscribers.

1955: Public phone calls cost 4d.

1958: Subscriber Trunk Dialling (STD) introduced to United

Sydney's 1940 telephone directory

There are still techniques to be learned and etiquette established, however, before video-conferencing becomes a part of everyday business life. Many people are likely to feel that face-to-face meetings on neutral ground are an important way of doing business.

Video phones, where desks are connected to the network, are likely to become a familiar sight. Callers can monitor each other's expressions and body language, and gain a more complete sense of the people they are dealing with. It would be a notable advance for the deaf, who can use the videophone to "sign" to each other.

Video telephony is still expensive because the wider band width required is costly. It is expected that people would only consider it if the cost could be brought down to about twice that of a conventional phone call. It would be an option for the user: people could screen calls before switching to video mode, and there would be no indication to a caller when a connection to a videophone was made.

Telecommunication industry observers believe the pattern of videophone use will resemble that of the fax. When the price is right, and enough people acquire the video facility, it is expected to take off.

Apart from personal communication the video phone has educational applications. A lecture can be given to a local audience, for example, and relayed to a wider audience through the phone system. Video material in a library can be called up at any time through the network.

Image databases can be set up. A visit to a real estate agent, for example, could include a look at his database of houses on offer; it would not be a substitute for a personal visit, but it would enable the selection process to be much easier. These would be still images; moving images would be much more expensive.

The face of marketing could change dramatically. "Electronic brochures" could be examined in shops or at home. Retailers could make their merchandise available this way, with information about sizes, prices and availability. There could be a link to the stock database, so that goods could be ordered and paid for by credit card over the phone.

Electronic news services could be supplemented by electronic magazines, giving visual images as well as text. These would have the advantage over conventional magazines of being on line and able to be updated instantly.

But if the visual telephone is still in its early stages, with an uncertain demand, there is nothing uncertain about the success of mobile telephones. Telecom launched its mobile phone service four years ago – now it has more than 250,000 customers, five times the number estimated in its orginal business plan.

The mobile phone was designed principally for the car, but in fact the fastest growing segment has been the hand-held market. The cellular phone, with its much greater range, is appealing to the business market, while the cordless phone, which can only be used close to home base, is a boon to people in domestic situations – looking after

Kingdom, enabling direct-dialled trunk calls.

1960: Crossbar switching, an improvement on the "step-by-step" switching method which basically followed Stowger's switching principle, introduced at Toowomba, Queensland in September. Crossbar exchanges used an electrical memory.

1962: Coaxial cable between Sydney and Melbourne established.

1963: The first lightweight handset telephone is developed.

A 1984 Touchfone

Company Coin Telephones (Red Phones and Easiphones) introduced – owned by private companies and leased as public telephones to clubs, hotels and shops.

1964: The wall phone is developed.

1967: The Ericophon, a horn-shaped phone with the receiver at the top of the handpiece and the transmitter in the base, heralds the beginning of phones designed for aesthetic appeal.

1968: First Australian link to a satellite.

1970: Australia now has 2,700,000 telephone subscribers.

1972: 10 million phones in Great Britain.

1974: International Direct Dialling (IDD) from the United Kingdom to Australia is introduced.

1976: The first advanced fully electronic exchange is set up in Chicago, beginning a gradual international change to all-electronic digital switching systems. Among other things, this leads to increased flexibility, because an electronic exchange operates by a stored programme, so that software can be updated without changing the hardware at all.

1977: Mr and Mrs Snell of Enmore NSW become Telecom's 4 millionth subscribers, receiving flowers, certificates and a year's free telephone rental.

1980: Australia has 53 telephones per hundred of population. The US, with 38 per cent of the world's telephones, has the highest penetration; Sweden, Switzerland, Canada, Denmark and New Zealand follow.

1981: Mobile phones introduced in Australia, enabling users to take and make calls while they are travelling.

1982: Optical fibre cables introduced; these have a greater capacity, are more reliable and do not distort electronic impulses.

1983: Introduction of Telecom's Transit conference +10, with hands-free dialling, redial and the capacity to store numbers which can be retrieved at the push of a button.

1984: Touchfone 12 inroduced, capable of bringing up to 10 callers together at once.

1985: Telecom begins market trials of the Nomad cordless

A 1986 mobile phone

phone, which allows the user movement within a 70-metre range of the base station connected to the telephone network.

Launch of the Computerphone, which combines six computer facilities in one work station. The telephone has hands-free dialling, abbreviated dialling coces, autodial and a directory. The computer adds calculating, word processsing, a spreadsheet and a filing and storing system, as well as a software version of BASIC for programming. Access to other

young children at home, for example. The cordless phone is also considerably cheaper, although cellular phones will undoubtedly drop further in price.

The cellular phone network divides metropolitan Australia into a honeycomb of cells, each with a receiving/transmitting device. As the user moves from one cell into the next the signals are automatically switched through.

One possibility which will expand the capacity of the cordless phone is the creation of "telepoints" – access points which act as base stations for callers with handsets. Anyone within up to 100 metres will be able to dial into the public network, rather than having to use a public phone. There will be no need for coins as the call will be charged to the user's number. Up to six calls could be made at once, so that queues will become a thing of the past. And public telephone vandals will no longer be a problem.

Although telephone equipment is getting smaller, there are certain physical limitations, one of which is the size of the battery. Battery technology has not advanced as fast as circuit technology. Until it does, the Dick Tracy-style "wrist phone", although certainly not an impossibility, will not be common until the next century.

Another exciting development in the mobile communications area is the proposed Iridium satellite system. Normally a geostationary communications satellite orbits the equator 36,000 km from the Earth; at this height and position, it appears to remain static. A satellite would be needed to give the rural areas of Australia mobile phone coverage, for example: but the technical problems of using a geostationary satellite to establish a car phone system would be immense.

The Iridium system would make this possible, however. It would launch 77 satellites to orbit just outside the Earth's atmosphere at a height of about 600 km. (It is named after the element iridium, which has 77 electrons in an atom). This proposal, developed by the Motorola company, is an application of the cellular principle on a global basis.

Building and launching such a large number of satellites is an extremely expensive undertaking, and cost and feasibility studies are still in progress. Early price calculations suggest a charge of about $US3 per minute for calls.

Ideally, people could switch from one system to another. But the greatest problem facing the future of the mobile telephone is the limits imposed by the electromagnetic spectrum. It is a resource with great demands on it. The government has control over some of it, radio and television stations use it, so do police cars, taxis and trucking companies, cellular phones, CB radios and satellites.

The technology created by Alexander Graham Bell has travelled far in the past century, but much of this ground-breaking development has occurred in the past decade. Fuelled by the demands of a world with an insatiable appetite for information, the future for the once-humble telephone is still enormous.

ENT OF THE TELEPHONE

computer facilities is also available. The market proved to be not yet ready for this system.

1986: The fax, short for facsimile machine, becomes widely available for international communication. The fax transmits images over a telecommunications link, usually the telephone network. An image is carried, read by a laser beam and digitally coded into signals which travel, via the phone lines, to the receiving fax machine, where the image is printed out, line by line, on heat-sensitive paper.

Fax technology is not new: since the 1920s, weather bureaus, law enforcement agencies and newspaper wire services have sent photographic images through the telephone lines. But cost has been an inhibiting factor in the past: only in the eighties has it been feasible for individuals to use the service.

1987: Telemarketing, the selling of goods or services by contacting potential customers on the phone, is growing faster in Australia than anywhere else in the world, according to the Amercan phone company AT&T.

The cellular mobile phone system, MobileNet opens in Australia.

Telecom introduces the credit card phone.

1988: It is estimated that 30,000 telephone taps, at a cost of £10 million, are carried out in the United Kingdom.

In November, a New York judge rules that it is acceptable to serve legal documents by fax.

It is estimated that Americans made $US3 billion worth of long-distance fax calls this year. It is predicted that this will triple in 1991.

A Federal grand jury in the US charges Kevin Mitnick with stealing computer programs over the telephone. He is held without bail and refused access to phones without supervision.

1989: MobileNet has its 100,000th subscriber, and almost doubles its subscriber base to 185,000 during the 1989-90 financial year.

Phonecard payphones introduced in Adelaide, with national installation to follow over the next two years They are operated by prepaid cards in denominations of $2, $5, $10 and $20.

IDD calls itemised on Telecom bills.

1990: The price of a local call in Australia rises to 22 cents.

Telecom household penetration: 94 per cent.

Women in Britain receive approximately 20 million obscene phone calls.

The Telecom Credit phone, which takes savings bank, credit or charge cards

The Philosopher and the Future

Will the future be ethical? Can the ethicists cope with the future? In the first of 21C's regular major interviews, PETER SINGER, *Professor of Philosophy and author, talks to Terry Lane about the point at which technology collides with morality*

PETER SINGER objects to being photographed cuddling kittens or puppies – but he doesn't mind having his picture taken with a pig or a rat. He reckons that there is too much sentimentality in our attitudes toward the treatment of animals and that it is time we extended the same concern to the less appealing laboratory and farm animals that we lavish on our pets. After all, it is on the intensive farms and in the laboratories of the pharmaceutical companies and the psychology departments of universities that animals are being subjected to the cruellest forms of physical and psychological torture. Rats and pigs need someone to represent their interests more urgently than do cats and dogs.

Peter Singer is Professor of Philosophy at Monash University in Melbourne and the author of *Animal Liberation*, the "bible of the animal liberation movement", first published in 1975 and recently republished in a revised edition by Random Century. Singer is also the director of the Centre for Human Bioethics at Monash University, which he established with two colleagues "to address the ethical and social issues which were arising from the new technology of in vitro fertilisation" – a technology in which the medical faculty at Monash became world leaders. He says: "We're not limited to looking at IVF. We look at a much broader range of issues. There is a general concern that there are a whole lot of new things happening in medicine and the biological sciences which have ethical implications. And there was nowhere in Australia where these things were really being studied at all."

Did the research scientists welcome your interest, or did they regard it as an intrusion?
I think most of them welcomed it. In fact one of the founders of the centre was John Swan, dean of science, and the other was Bill Walters, professor of obstetrics and gynaecology. They saw the need for broader social involvement in the ethical issues that the new technology was raising. So I think that's a good example of enlightened scientists aware of the problems and not wanting to narrow the turf and keep other people out, but just the reverse.

The acceptance of our interest wasn't universal, but I think it was probably the view of the majority of people involved in the IVF program. The medical faculty as a whole, I think, came a little more slowly to an acceptance of the importance of bio-ethics, but the dean of medicine at the time was a supporter of the centre from the early days.

How did you come to develop your special interest in the morality of the treatment of animals?
That came about more or less accidentally. While I was a post-graduate student at the University of Oxford, studying ethical issues – but not at all ethical issues involving animals at that stage – I happened to become friendly with some other graduate students who were ethical vegetarians. I got into long arguments with them about the basis for their diet and of their views about animals.

Initially I thought, as most people would, that animals had a quite different moral status from humans. But in fact, in the course of discussing it with them I convinced myself of the opposite – that there wasn't a justification for the way we were treating animals – that we were sacrificing their major interests for rather minor interests of our own, and whatever else you might say about differences in status of humans and animals they weren't sufficient to justify that. So it happened to fit in with the philosophical work that I was doing, but had I not met those people I might never really have thought about these issues in any depth.

Can you put concisely your basic concept of the spreading circle of the concern that will include animals.
I think the easiest way to put it is to think of our views now about the very crude and blatant form of racism of the slave traders who thought that it was acceptable to go over to Africa and capture Africans and regard them as useful tools and objects to be sold to the plantation owners in the United States – despite the obvious enormous costs to the slaves in terms of their sufferings that they experienced, the break-up of their families, and all the rest of it.

We now think of that as outrageous because we can see the suffering that that involved for the slaves, and we don't regard the distinction between Europeans and Africans as in anyway justifying that. Now, we've therefore expanded our circle of concern compared to those of the slave-traders to include all human beings. But we still have a boundary on that circle of concern, and that boundary is now the boundary of our species.

Obviously this is not an absolute boundary – we're opposed to some forms of cruelty to some species of animals – but very largely that marks the point at which we take really seriously the interests of beings.

I believe that the relevant factors in considering the interests of living creatures are neither matters of race nor matters of species but things like the capacity to suffer, and therefore I think that we ought to expand the circle of concern beyond the boundary of species to include all beings who are capable of suffering.

This has led you to make some startling statements about, for instance, the relative rights of a chimpanzee, which is obviously able both to feel and anticipate pain and, say, an anencephalic child. You have said that there is possibly more justification for experimenting on such a child than on a chimpanzee.
That's right. I think that you ought to consider the beings as they are and, while it may sound shocking to some, certainly the chimpanzee is far more aware of what is going on, capable of suffering, capable of forming lasting attachments to other beings, and in that sense is a more morally significant being than an anencephalic who, although undoubtedly biologically a member of our species, lacks the brain and therefore lacks the capacities for any of these things – for forming attachments with other beings, even for recognising his or her parents – and presumably lacks all capacity for suffering as well.

If you looked forward to the year 2001, do you think that your views will be more generally held?
I think that's likely. I think there's already been a considerable change of opinion over the last ten or fifteen years, to go back to when I first began to form my views. It's really quite amazing when you look at what is now almost universally accepted by scientists, for instance, in terms of the need for controls over animal experimentation.

There is now a greater concern and respect for animals and a willingness to avoid doing large categories of tests, such as the notorious Draize eye test (in which concentrated solutions of new products like shampoos are dripped into animals' eyes and the damage measured), or the LD50 — the lethal dose 50 test — to determine the dosage at which 50 per cent of the test animals will die. These tests were being done without any question at all fifteen or even ten years ago, and were being defended as quite proper by any scientists who did discuss it.

This is one example where thinking is changing, but I think there are others as well — the change of consciousness about fur, for instance, which again was something that no-one really thought about ten years ago; the opening of duck season, for example, never attracted any condemnation or criticism ten years ago. On all of these issues I think we've seen a great deal of change, and I would certainly expect that to continue in the years up to 2000, because I think the change is a reflection of what is basically a recognition that our conventional moral views on this have been unsound.

In the discussions of the moral problems posed by the advances in medical science, we get the impression that the ethicists now are scrambling to keep up with the scientists, and generally lagging behind. Must it always be so?
I don't think it has to be the case. I suppose that when something new and unexpected happens in science, there's always going to be a scramble for ethicists to take account of that. And because of the nature of science there are always going to be unexpected developments turning up, so there will be a bit of lag. But I think that we can look into the future to some degree and we can, therefore, reduce the extent to which ethics lags behind science, and I think we are already doing that.

The whole field of bio-ethics is a relatively new one, very much over the last decade. Before then there weren't really any ethicists around looking at ethical implications in the sciences, so that very often when something happened the press didn't even know where to go for a comment. They might go to a local bishop, but if they went to a philosophy department they probably would have got a rather blank response, because philosophers were not looking at those issues.

Now we have a network of people doing bio-ethics around the country – indeed around the world. We have an Australian association for bio-ethics and an international association for bio-ethics just forming. So there are people looking at these issues, and to some extent they can look ahead.

The best example of that is probably the human genome mapping project: an international project that is intended to map and sequence the human genome, which will greatly enhance our knowledge of the genetic components in both our physical and behavioural lives with a number of foreseeable ethical problems that are going to arise from that. And because of those problems the United States department that's putting money into this project through national institutes of health, for example, has actually specified that it's setting aside three per cent of the total budget for investigation of ethical and social

implications. So that even before the scientific work has been done, we have people who are putting up research projects to try and see what the ethical dilemmas are going to be that result from it.

What do you guess they're going to be?
Well I think there are going to be quite a number. They range from things that are in a sense relatively mundane, and are bound to happen, such as questions of workplace genetic screening. We already have corporations which conduct health tests before they employ people. If they add to those health tests genetic screening on the basis of a much more detailed knowledge of what genes do what, we're going to have much finer forms of discrimination. We may then find people who are unable to obtain certain kinds of employment because of what the corporation reads in their genes – that they are perhaps a poor risk. Now, we're going to have to consider whether we want to allow corporations to do that. If so, how we can assist the people who therefore find employment more difficult; or if not, how we prevent the corporations from doing it.

At the science fiction extreme of things we have the idea of made-to-order babies, I guess. That you could take a cell from an embryo, look at its genetic structure, know a great deal about what sort of a child or person that embryo would grow into, and then select whether or not to go ahead with a pregnancy based on that embryo on the result of that knowledge. To do it at the embryonic stage would require people to use in vitro-fertilisation or an artificial reproductive technique like that for every pregnancy, and that's something that most people wouldn't want to do – though it could be done also during pregnancy if women were prepared to abort those foetuses that didn't measure up genetically. Of course they already do that in the case of serious genetic defects, but would they be prepared to do it with the much finer detail of what the genome of that child would be?

Will we come to accept the growth of foetuses on artificial placentas as sources of useful tissue?

If you had people walking around with diseases, knowing that they were dying, or in a progressive state of decline, and this were the only way to arrest their disease and it effected a cure, my guess is in the end we probably would come at that kind of rather grizzly sort of cultivation of the human foetus.

You talk about it as though it were in the realm of science fiction. But aren't some of these eugenic projects already commonplace in animal breeding?
Certainly they are in animal breeding. Of course, we're prepared to put animals through a lot more than we're prepared to put humans through.

And so in a way you could look at what's being done with animals now and guess what might happen to humans in ten years' time.
Well it might, but it's uncertain whether it would. There are obviously some things that have been happening with animals for quite a long time that we don't do to humans. I mean, before we even got any new genetic techniques farmers were always breeding from those cows that produced more milk. We have not copied that. Apart from Hitler, we have not tried to prevent humans whom we consider to be less than ideal from reproducing and we have not tried to get those whom we consider to be most ideal to reproduce on a large scale. So there's no necessary inference from what we do.

Lee Kuan Yew tried to do just that.
Well, I guess, aside from the horrendous Nazi examples, Singapore has gone further in that direction than anyone else in that they do actually have incentives to couples who have university degrees to have more children and disincentives to couples who have no education to have children. Yes, that's the closest that we've seen.

That is crude eugenics, of course. But if Lee Kuan Yew could have intervened at the embryonic stage and selected the ideal characteristics for the next generation of Singaporeans, why wouldn't he?
I don't know. I can't answer that because I'm not in Lee Kuan Yew's position. But, yes, I think you're right: if we get to the point where we understand which genes are connected with intelligence – and that's not going to be simple, because it's obviously not going to be just one gene, but is going to depend on a number of genes interacting – if we ever do get to understand that, then it would be possible for someone with the views that Lee Kuan Yew holds to actually be more effective, more successful, in trying to breed a more intelligent population than has been possible without that knowledge of the genes that are related to higher intelligence.

And how could you stop it?
Once the knowledge becomes available, obviously you could only really stop it in your own country by the usual democratic processes. But if someone in a dictatorship wanted to go ahead with it I don't suppose you could stop it.

The first eugenics program involving manipulation of the embryo will probably be about targeting the gene that predisposes a person, say, to diabetes, or to sickle-cell anaemia and changing that characteristic. The more sinister applications of genetic research, then, will surely be an inevitable spin-off from this benign research?
Well, I certainly agree with the first part of what you said. I do think that we will concentrate on correcting or eliminating things that everyone would agree to be a defect, and that's really what I had in mind when I said that the other things about breeding for, if you like, superior characteristics and qualities, was probably something of a science fiction speculation, at least for the next decade or so. I think there is certainly great potential for good in terms of reducing the number of genetic diseases that cause an immense amount of suffering and distress, and that's one of the reasons why I think going ahead with the human genome project can be defended, despite the possible longer term malign consequences that could arise.

If we go back to 1945 when the atomic bomb was dropped on Hiroshima, a lot of the discussion then was about the moral responsibility of the scientists themselves. How could they have embarked on this project knowing what its consequences were going to be? Perhaps we've now come to the position of saying that science is driven by curiosity and that we can't expect scientists to stop their line of inquiry because its application may be malign.
No, I don't think that scientists in general would necessarily accept that view. Scientists have sometimes themselves restrained their work. The best example of that, I guess, is the moratorium on research into recombinant DNA and genetically altered bacteria that scientists introduced after a conference in the US a few years ago. That was in order to avoid possible dangers of nasties escaping, if you like, new biological evils resulting from recombinant genetic engineering. Then when scientists became convinced that there were safeguards that could be put in place, the moratorium was lifted. That was an exam-

ple of scientists themselves restricting their research because of dangers that they saw, and in doing that they were taking responsibility for the possible consequences.

If ever we are able to choose the characteristics of our children it will cost money, and we may then have a class of genetic rich and a class of genetic poor. How will we cope with that? It will make the argument about private and public schools look very trivial.

It certainly will. The first question, though, is whether we will allow people to genetically select their children for anything other than the elimination of clear defects. See, if we stick to the elimination of defects, then that will be a medical procedure that will be covered by medical insurance in the same way as actually treating the genetic disease would be covered and reimbursed. So I don't see any problems with that class division at that level. But of course if we get to the point where people are trying to make sure that their child is, I don't know, a good athlete or able to do well at maths, or musically talented or whatever else it might be then, yes, I suppose it won't be a medical procedure and there will probably be laboratories set up to offer those services on a commercial basis.

Now, society could simply make a decision to prohibit that. I think some societies will – Germany, for example, has already prohibited any of that kind of research that might lead to tinkering with the human genetic constitution. They're obviously particularly sensitive to anything that smacks of eugenics. Other societies might well do the same. But the difficulty here is it's only going to take a small number of societies to refuse to do that to create an elite who can travel to those particular places and obtain those services. And I think it is likely that that is going to happen somewhere, and it will mean that those who are wealthy can afford to obtain certain genetic qualities that those who aren't wealthy can't – and that's a frightening thing.

We can hope that it'll turn out that not so much is genetically controlled as we think. That things like intelligence have a larger environmental or, in some other way unpredictable basis. But, you know, that's optimistic. The indicators are not very encouraging.

DAVID JOHNS

An issue which is probably going to become more urgent in the next three or four years is the extent to which we allow the use of foetal tissue for experimentation or transplant. Already tissue from aborted foetuses is being used for therapeutic purposes. Will we come to accept the growth of foetuses on artificial placentas as sources of useful tissue?

The first question is whether that would be necessary. It would be an expensive, complicated procedure. We can't at the moment grow embryos beyond about 11 or 12 days. No doubt at some stage we'll learn how to do so, but given that there's likely to be a supply of tissue from aborted foetuses, the question is what we'd actually gain by attempting to breed foetuses. The possible gain might be that we would obtain tissue that was less damaged, and that's something that I guess could be significant if we find that foetal tissue can be used to cure a range of diseases. Certainly it has been suggested that it could be for Parkinson's Disease, diabetes, and so on, and it may turn out that the tissue from aborted foetuses is too damaged to be useful for this.

Now that might depend on the method of abortion. You see, there are methods of abortion which effectively produce a living foetus, and if – and here's another ethical question – women can be persuaded to avail themselves of those methods in order to help someone with a disease, that would seem to me to be a much more likely source of tissue than specially growing foetuses. Just for economic reasons, really.

It may be that those are not the methods of abortion that are best for the women, and then I guess there may be pressure to actually grow them in vitro. I'm not sure. I think that the pressure would be very strong if it could be shown that this was the way to save the lives of specific people. In other words, if you had people walking around with diseases, knowing that they were dying, or in a progressive state of decline, and this were the only way to arrest their disease and it effected a cure, my guess is in the end we probably would come at that kind of rather grizzly sort of cultivation of the human foetus. But we'd do so reluctantly, I think.

The history of moral philosophy from Moses until quite recently has been the intellectual quest for some sort of universally applicable ethical formula. The search has been for a Golden Rule which, if applied in all circumstances at all times, will lead to the greatest sum of human contentment. Has the nature of moral philosophy changed? Is there still a conviction that a golden rule is what is needed – a sort of universal moral touchstone?

Yes. I actually think that something of that sort is very important in ethical thinking. That the imaginative exercise of putting ourselves in the position of all those affected by what we're doing, and asking myself would I want this done if I had to live not just my life but the lives of all of those affected by either doing or not doing this? I think that that's a very useful way of trying to resolve moral issues, because it has no particular bias towards my views, or even my culture, as against someone else's. It's not that I'm imposing a rule that is to be found in the Christian scriptures, for example, and therefore there's no reason why a Muslim or a Buddhist should take particular notice of it. It's something which gives an equal status to all those affected, and indeed interestingly enough, it can be found in one form or another in a great range of different cultures. Not just in Christian thought, but in Confucius or the Hindu scriptures or wherever. So it does provide something that I think is still very useful in moral reasoning.

We obviously live in a post-religious age, and the children are no longer getting from their religious instruction an introduction to the idea of the over-arching ethical framework. Should ethics be taught in school?

I think that philosophy in general ought to be taught in schools, even in primary schools. Not in an academic way, but in the sense of stimulating children to think about the deeper philosophical issues, because I think children are curious about them. The teaching should

include discussions of ethics – not as ethics, not in terms of looking at codes of ethics or anything like that, but rather looking at a situation which you might find yourself in, and asking: what ought I to do? And, then take it a little bit beyond that, you know, once you say I ought to do this or that, well why do you say that? Why do you think you ought to do this? And I think children are capable of actually reflecting on those sorts of issues, and I think it is much better in fact than teaching them a religiously-based ethic as a set of rules to be handed down and obeyed.

It could be as problematical as sex education.
Oh, easily, yes. I'm sure that some people would find it disturbing, because once you start thinking about ethical issues you find that some widely accepted views might not be the ones that the children come to accept once they've thought about them a bit more. And that's going to be disturbing to people who've always accepted those views in a somewhat uncritical or unquestioning way.

What might be the big ethical arguments in the next ten years?
At the moment we're at the stage where in Australia we have just very recently come to accept that people have the right to say, "No, I don't want any more medical treatment, thanks. Leave me alone. I want to die in peace." That's relatively new. In Victoria, just in the last year or two, we have seen the Medical Treatment Bill, which will give people that legal right. In NSW, I just saw that the Australian Medical Association has asked the government to provide legal protection for medical practitioners who don't provide life-prolonging treatment for patients at the patient's request, so that the patient can die. And that's an interesting shift, because originally the medical profession was opposed to any sort of legislation in this area.

But, you know, once you get to the point where we accept that patients have the right to say "I don't want that machine. I don't want that treatment, even though I know that I'll die sooner without it", then we're going to get to the question of when patients are not going to die quickly or painlessly just by withdrawing treatment, but they actually want to control their own treatment – they want to have something active done to assist them in dying.

It's only in the last few years that one country has actually begun to openly give patients that assistance, and that's the Netherlands. I think in ten years' time we will have been able to judge whether that experiment in the Netherlands in allowing the open practice of voluntary euthanasia has or has not been a success. Whether it has or has not led to a lack of respect for human life or to abuses, and other things which its critics suggest it will. And I think that if in fact it turns out that that experiment is successful, and is regarded as desirable by the population, then a number of other countries will be doing the same thing. So the idea of giving people control over their way of dying will become a major topic for discussion and perhaps our attitudes will have been quite significantly transformed in the next decade.

What might be the big ethical arguments in the next ten years?

We have just very recently come to accept that people have the right to say, "No, I don't want any more medical treatment, thanks. Leave me alone. I want to die in peace." But, you know, once you get to the point where we accept that patients have the right to say "I don't want that machine. I don't want that treatment", then we're going to get to the question of when patients are not going to die just by withdrawing treatment, but they actually want to control their own treatment – they want to have something active done to assist them in dying.

Even in the Netherlands what they do is paternalistic. You still have to ask the doctor. Will we ever arrive at the point where we say that every individual has the right to decide when and how she will end her life, and that that means that she ought to have access to whatever is clean, useful and painless to bring life to an end without the intervention of another person?
Well, I think the justification for requiring the intervention of a doctor is that someone ought to make sure that the person has thought carefully about this decision and fully understands the consequences. I mean, I don't know that I'd favour the idea of just walking into any chemist and buying something which, if you take three of them, will kill you.

Imagine this conversation in the year 2001 – what are we talking about?
We are talking about the moral implications of the way we obtain our food – for three separate reasons. One is the animal welfare aspects of factory farming, which have been increasingly of concern to people. The second is the environmental aspects of it, both in terms of the incredible waste problems that you get when you concentrate animal wastes on a small area for huge numbers of animals. And the third cause for concern is the waste and inefficiency involved in feeding animals on food grown on crop land, rather than letting them graze on grass which we cannot turn directly into protein.

We could be producing a lot more food and therefore feeding a lot more people if we were not rearing animals in these particular ways. If we were not relying so heavily on animal protein obtained from crops that we have ourselves grown. Since 1991 there has been a rise of ethical concern about this, and an increase in the shift, which you can already see in food consumption figures – away from a diet that's so heavy in animal protein.

One aspect of this that involves new technology is the development of, if you like, meat look-alikes; cell-cultured animal protein products that are indistinguishable in taste and texture from products taken from animals, but are produced synthetically. There was initial resistance to that, but when it was shown to be nutritious, economical and much better from an environmental, as well of course as animal welfare point of view, than factory farm produce, then the acceptance increased and it greatly changed the way we obtain our food.

Born in 1946, PETER SINGER is Professor of Philosophy at Monash University. In 1987 he became full-time director of the Centre for Human Bio-ethics at Monash, of which he was a co-founder. He is a member of the Victorian government's Animal Welfare Advisory Committee and a member of the CSIRO advisory committee on the ethics of animal research.

His best-known book, Animal Liberation, was published in 1975, published again in a revised edition in 1991. His other books include Animal Factories; The Reproduction Revolution and Should the Baby Live?. He is the author of the major article on Ethics in the current edition of the Encyclopaedia Britannica and is co-editor of the journal of the Centre for Human Bio-ethics.

Telecom


Andrew Lucas

Age of Light for Telecommunications

Australians are just beginning to grasp the significance of one of the largest telecommunications projects in the history of our nation. Over the past 10 years or so, major advances have been made in both the development and application of optical fibre technology. For several years Telecom has been rewiring the nation to modernise the communications network for the 21st century and beyond. The result of Telecom Australia's massive optical fibre program will be a whole new world of communications, which will have implications for every person either directly or indirectly. The project, all underground, centres on replacing existing copper cables with optical fibre. This provides the basis for a range of advanced services and facilities including home shopping and banking, pay TV, video phones, interactive video and electronic data transfer.

Home Shopping, Banking

The benefits of optical fibre will become increasingly apparent to all Australians as the range of domestic services broadens. Most homes today have a single connection for the family telephone. In the not-too-distant future, optical fibre will allow for fax, phone, cable services such as TV, home shopping, banking, specialised movie viewing and a host of other services. Consumers will be able to call up a supermarket on their television screen – by using the keypad on their phone or a 'joystick' – and then 'travel' through computer-generated supermarket aisles. They will choose grocery items and decide delivery time and method of payment without leaving their chair. Doctors will be able to check x-rays from distant locations within seconds of the photo plate being developed.

Bank staff will be able to clear cheques presented at distant locations, saving time and improving customer service.

Intelligent Buildings

Optical fibre technology will become increasingly important as computing, broadcasting and telecommunications merge into the one industry. The office of tomorrow will use video conferencing, off-site data storage and retrieval and data transfer in a fraction of the current time. Already, buildings with fully integrated services and telecommunications are starting to appear in Australia. These "intelligent buildings" can offer tenants shared access, not only to building services, but also to a full range of telecommunications facilities. Tenants can share access facilities such as PABX, voice mail, facsimile, telex, after-hours telephone answering, data processing, video and paging. This is particularly useful for small or medium-sized businesses. In this environment, Telecom is introducing optical fibre cabling which will help to give Australian businesses internal and external communications equal to that of any international competitor. Australian businesses are establishing interactive data gathering and dissemination systems, and office automation technologies, specifically designed to support the information needs of an increasingly sophisticated and competitive marketplace.


Optical fibre close-up

Telecom is providing a quality service to match, which will benefit all Australians.

Optical Revolution

The introduction of optical fibre technology promises to bring more change to an information-hungry society than any other new technology likely to be available this century. An optical fibre is a pure glass rod with a diameter less than that of a human hair. If the fibre is encased in a suitable cladding material, a laser light pulse injected into one end will be emitted at the other end, even if the fibre is not straight.


Andrew Lucas

Researcher Chris Byrne tests optical fibres to assess suitability for a fibre amplifier

Telecom's Network Management Centre, Melbourne
Inset: Optical fibre cable

Copper wires carry a telephone conversation, for example, in the form of electrical pulses. An optical fibre carries the signal in the form of light pulses, ie. the light source is turned on and off very quickly – in fact, millions of times a second. The main advantage of optical fibre lies in the very high rate at which optical signals can be transmitted. As well, signal loss in optical fibres is much lower than in copper wires. This means that optical fibre cables can span long distances between repeater stations, in Australia a necessary feature. Optical fibre cables are the way of the future: they will allow Telecom to develop a network which makes available the most modern business facilities, and they are 'future proof' because they can be continually upgraded.

Herve Allesume

Speed of Light

Optical fibre technology has developed astonishingly fast. The development of the laser in the early 1960's led researchers to consider using light beams to transmit signals. Early attempts at free-space transmission were not particularly successful and it was not until 1966 that the use of a transparent guiding structure – in effect, an 'optical wire' – was proposed. The first practical all-glass fibre was made only in 1973, yet, by the end of the decade, manufacturers around the world were switching their copper cable plants to facilities making optical fibre cables. Optical fibres have enormous capacities to transmit information. The Melbourne-Canberra-Sydney cable, which can ultimately carry the equivalent of several hundred thousand simultaneous telephone conversations, is only as thick as a thumb. Providing the same capacity using earlier systems would require four coaxial cables, each 10 centimetres in diameter.

Andrew Lucas

Optical fibre

Because of their small size, light weight and flexibility, optical fibre cables are cheaper to lay than copper cables. The need for fewer booster stations (repeaters) provides another saving. Optical fibres also have a number of other advantages: they need not contain any metal, a feature which eliminates the risk of lightning damage: They are also immune to static interference; and it is difficult to tap optical fibres without interfering with the transmission – a useful characteristic for security.

Andrew Lucas

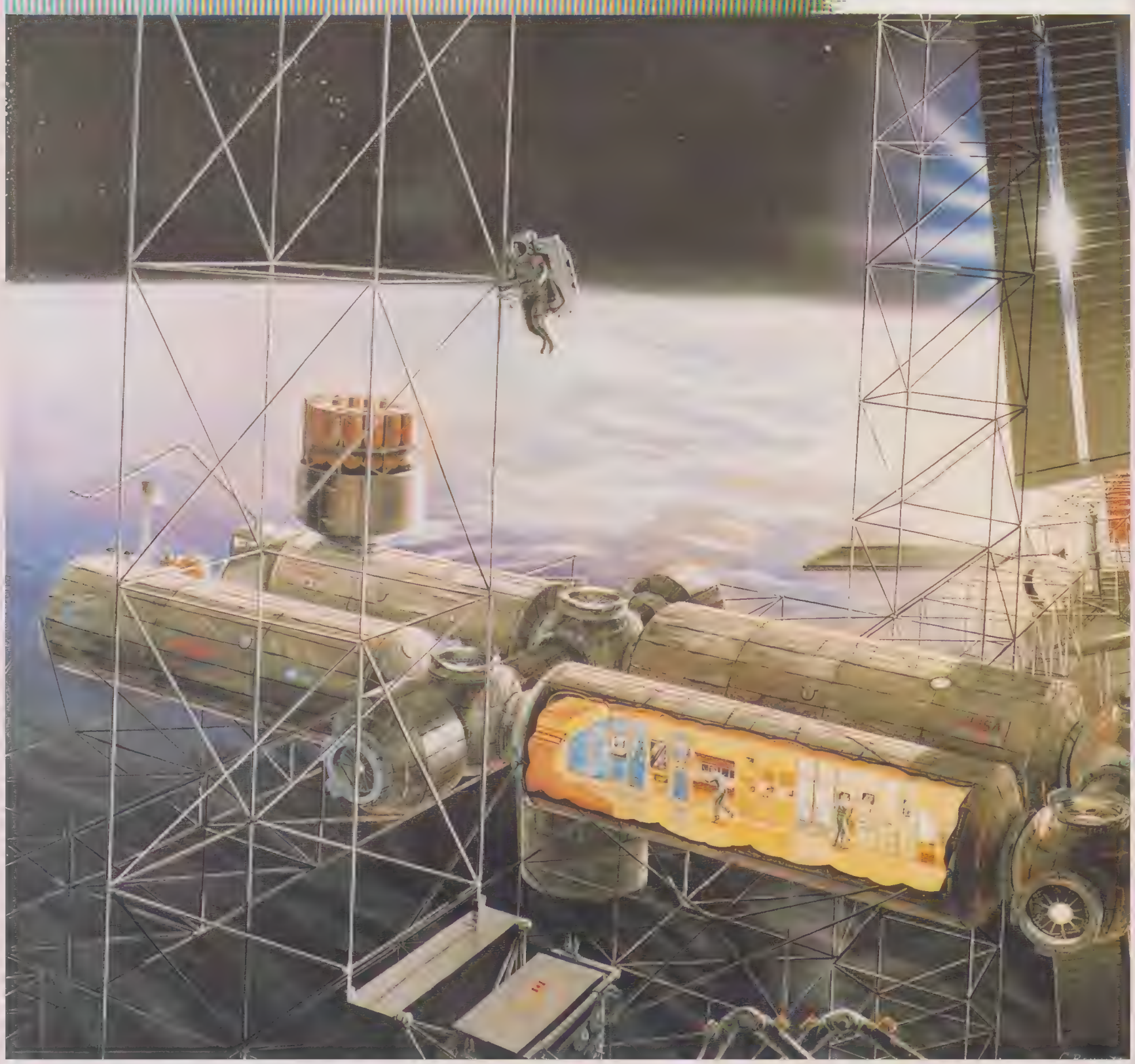
TRL is a major contributor to standards both in Australia and internationally

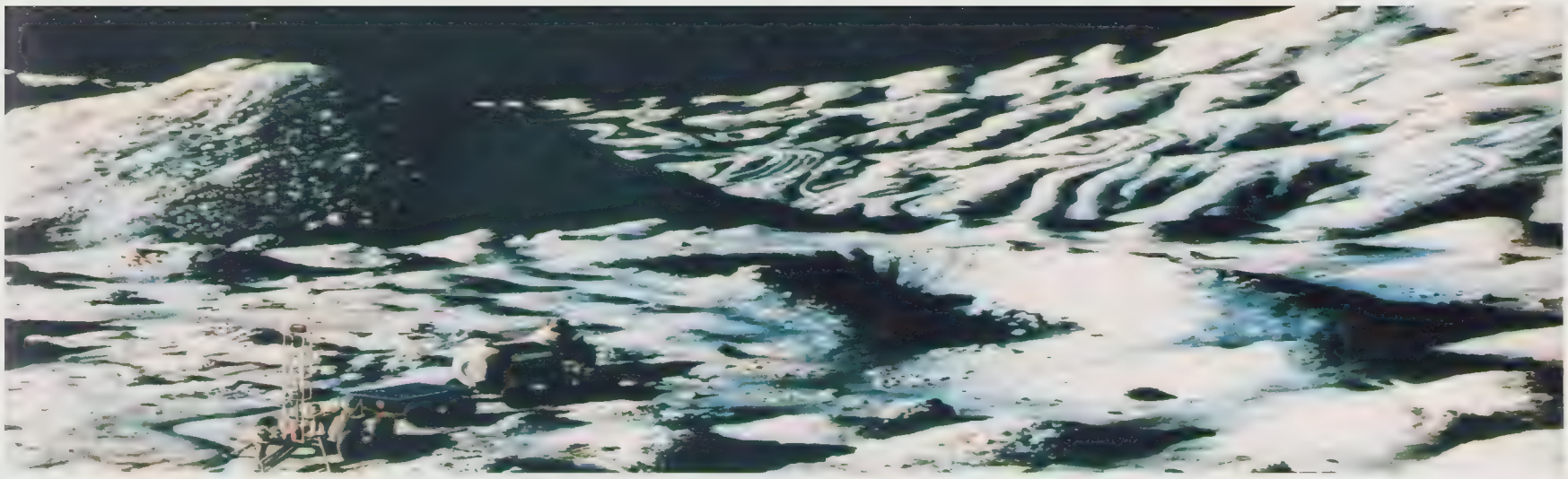
World Leader

Telecom's decision to introduce a residential optical fibre network puts Australia among world leaders in this technology. At present the cost of providing optical fibre to the domestic customer is still quite high when compared with copper cables. But, it is anticipated that by 1995 the costs of the two systems will be on a par, making optical fibre the likely choice as a replacement. As a result, more and more telecommunications companies are exploring the domestic applications and capabilities of optical fibre. In the meantime, Telecom is busy implementing its technological breakthroughs. It is estimated that some 500,000 kilometres of optic fibre has already been laid in Australia, much of it across desert and other inhospitable terrain. The development of optical fibre cable links direct to private homes is being tested in a project involving 200 homes in Sydney and Melbourne. Results of these and other trials will help Telecom assess installation, application and maintenance requirements.

Right: This painting, used as a visual at a conference in Houston about lunar bases and space strategies of the 21st century, shows a deep exit from stunning cores for petrological studies of the floor units of the 26 kilometre, 4250-million crater Aristarchus. The peak of Aristarchus is a few kilometres to the south of the drill rig. This perspective from the crater floor shows the prominent slump terraces of the crater walls and the solidified impact melt flows which flowed down the steep inner wall immediately after the crater was formed.

Below: A close-up view of the four interlinked modules, part of the specific configuration of the permanently manned space station being developed by NASA for operation in the mid-1990s.





VING IN SPACE

Science fiction writers have us up there fighting aliens. But when we put fantasy aside and voyage beyond Earth, researchers believe our greatest enemy will be our own bodies

By GEOFFREY BURCHFIELD

IN JULY 1997, four American astronauts will climb out of a space shuttle, pass through an airlock and board the orbiting space station *Freedom*. Safely housed in pressurised modules, they will launch a 30-year programme of orbital enterprise and space research. Their objective – the same as the Soviets, whose *Mir* space station has been aloft since 1986 – will be to establish a permanent human presence in space.

It will be the next significant step for mankind in the process of space exploration that had its prelude in 1961 when Yuri Gagarin became the first human in orbit. By the time Apollo 11 landed two men on the moon, just eight years later, it must have seemed to many people that lunar bases, space stations and Mars were ours for the asking.

Then the nerve of US and Soviet governments began to fail, grounding any such grandiose plans. It has only been since the mid-1980s that space planners have dared to dream again, even if their enthusiasm has so far failed to recapture everyone's imagination.

But it is all far from a foregone success. The extreme precision with which massive payloads can be lifted into orbit now seems so commonplace that we can easily forget the human element. Weightless and equipped to the teeth, the astronauts we see on the nightly news move with such apparent ease that the challenge of living in space already seems to have been met.

On shuttle flights, lasting just a few days, that's more or less true. There is always the option of dashing back to Earth if a problem arises. But really living in space – sustaining the whole gamut of human activities in a sealed cabin for months or even years at a time – involves complexities beyond most people's imagination.

To give some sense of the problem, imagine eight people locked for three months in a room not much bigger than a bus. They can't open the windows for fresh air; there's no water or electricity connected; no-one to deliver food or other supplies or to cart away their garbage; and they are weightless. Their ability to survive depends totally on what is in that room.

In order to succeed, NASA and the Soviet Space Research Institute in Moscow have attempted to take into account every eventuality. They must put themselves in the gravity-assisted shoes of their future astronauts and produce life-support systems so perfect that what the astronauts breath, eat and drink today won't return to poison them tomorrow.

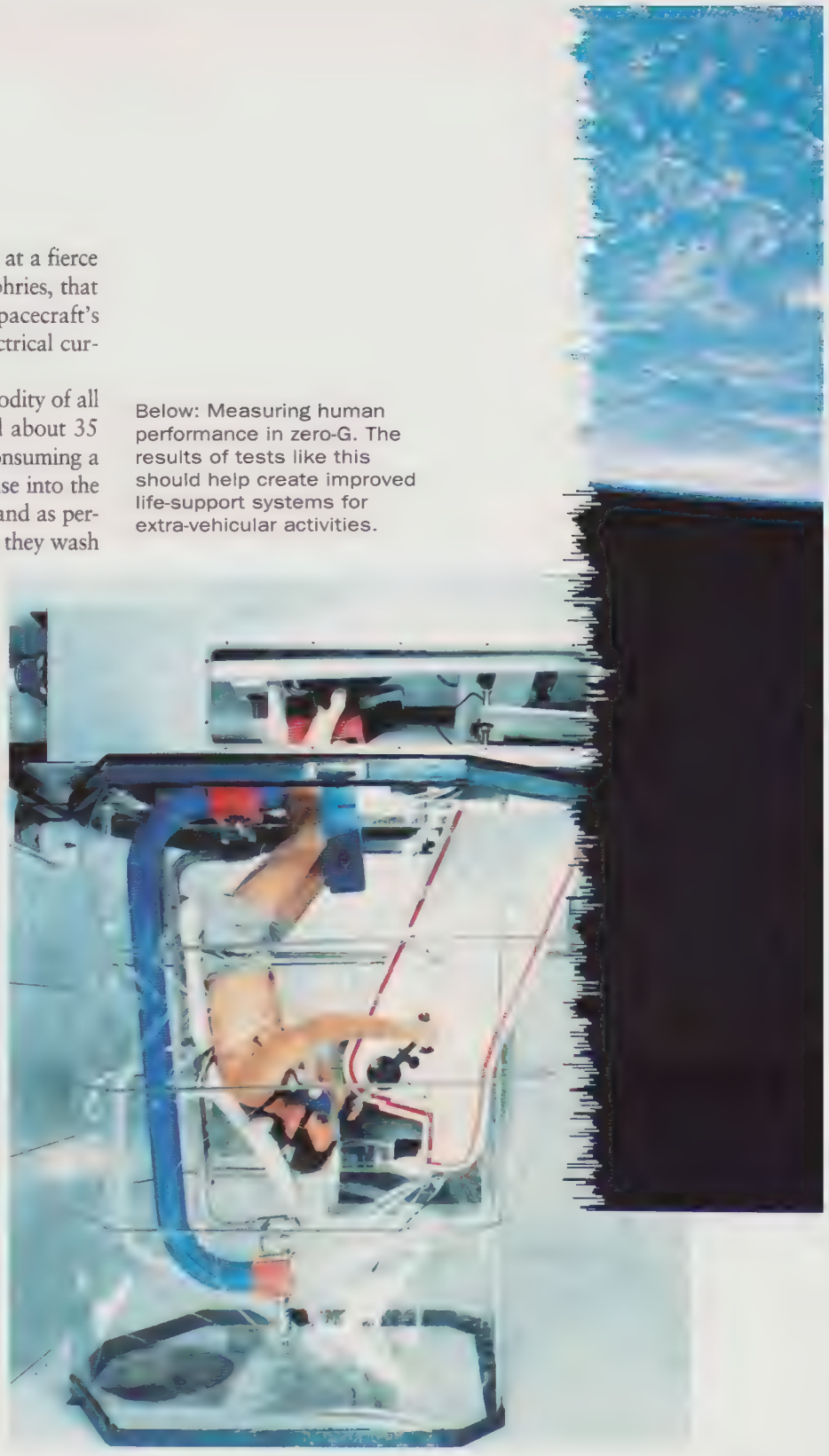
Engineers at NASA's Marshall Space Centre in Huntsville, Alabama, have discovered just how difficult that is. They are finding that even the most carefully designed recycling unit that generates an artificial atmosphere as pure as mountain air often creates contaminants like cyanide gas in the process; only a miniscule amount, but accumulated over months and years maybe enough to kill. Nevertheless, NASA scientists in Huntsville, Alabama believe they've now solved the problem of oxygen recycling. It involves taking exhaled

carbon dioxide from the air and burning it with hydrogen at a fierce 950 degrees. According to project engineer, Randy Humphries, that leaves you with methane (a handy supplement for the spacecraft's propulsion system) and water. Zap the water with an electrical current and you've got oxygen for breathing.

Then there is water, probably the most precious commodity of all aboard a spacecraft. Every day, a crew of eight will need about 35 litres of water just for drinking and washing, as well as consuming a little extra in their food. In the same period they will release into the cabin 15 litres of water as vapour exhaled in their breath and as perspiration; and of course they'll generate waste water when they wash (9 litres per day) and urinate (16 litres per day). Over a 90-day mission that amounts to a staggering 3,600 litres of waste water, a figure which does not include the water generated by equipment such as fuel cells. All of which means that if the storage tanks are not bigger than the spacecraft, water has to be recycled. To date, every time engineers have tried to design a water recycling system, they've ended up with more filters, tubes and bottles than a mad scientist's laboratory ... and water still too contaminated to drink. US researchers at the Marshall Spaceflight Centre are confident they can come up with the goods but at a cost more in keeping with French champagne.

Food serves up another challenge. While space food has to be nutritious, it also has to be interesting, otherwise no-one may want to eat it. The days when dinner came out of tubes and tasted like nothing at all are long gone. Take, for example, the cosmonauts aboard the Soviet *Mir* space station. Their menu includes smoked salmon, quail and, yes, borscht. But there are only two or three of them up there at a time, and they get regular supply visits from Earth. Catering for a crew of eight or ten on a two-year round voyage to Mars calls for some really mean cuisine.

Dr Selina Ahmed, a human nutrition expert at Texas Southern University, believes that a poor choice of food on such a mission could destroy morale. With researchers at NASA's Johnson Space Centre she's been assessing the taste, aroma, nutritional value and packaging of ethnic cuisine from a variety of countries. The objective is to find foods that are internationally acceptable, thereby reducing the need to develop individual menus for each astronaut. Foods that are selected, and can pass three-, six- and twelve-month shelf-life tests will be recommended for the space station larder. Among the short-listed dishes so far are veal scallopine with crab and broccoli, Turkmenian pilaf with chicken, and shrimp tempura.



Below: Measuring human performance in zero-G. The results of tests like this should help create improved life-support systems for extra-vehicular activities.

And if astronauts on a long space flight get bored with packaged food and start dreaming of things like crisp lettuce, there could be good news. At the Kennedy Space Centre in Florida the CELSS project (Controlled Ecological Life Support System) under scientist Dr William Knott has spent three years growing and harvesting crops – including juicy lettuces – in a two-storey bubble-shaped chamber. The aim: to produce a prototype space garden. That doesn't sound so different until you hear the requirements they have to comply with: high quality, high yield vegetables to be grown in just a small area without soil, sunlight or gravity.

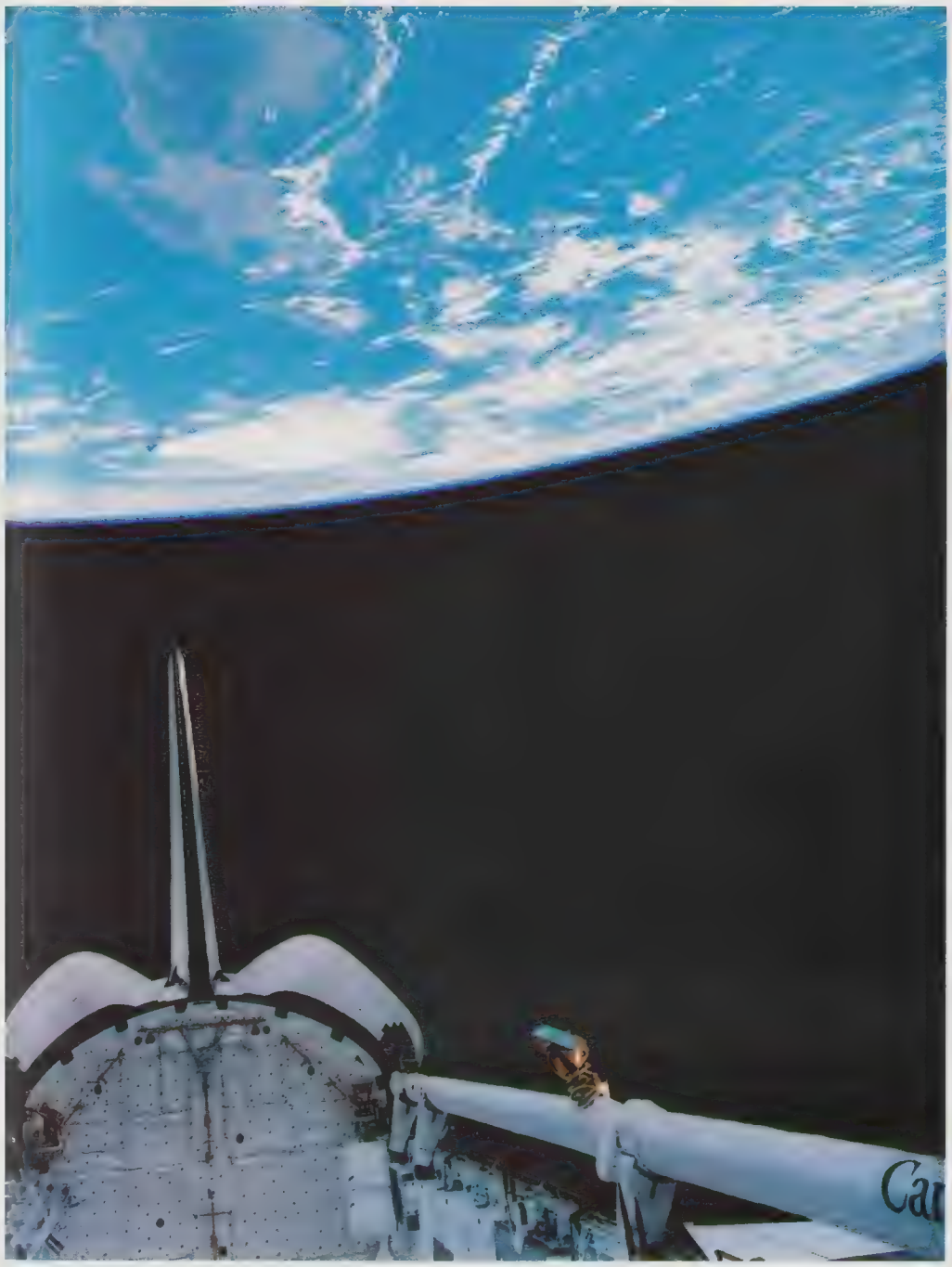
Soil is the easiest of these to live without. It's much too heavy to cart up into space anyway. But lack of sunlight is a bigger problem. Inside a spacecraft sunlight for plants is not exactly a high priority and there are certainly no plans for window boxes on the space station. More particularly, since the station will orbit the earth every hour or so, the fluctuating levels of sunlight would delete a plant's circadian rhythms essential for its growth.

And then there is gravity. Without it, how can a plant tell which way is up and which is down, and therefore decide which way to send its roots and leaves?

The CELSS team has tackled these problems head on. They report that the computer-controlled environment of the growth chamber is now so sensitive that it even responds to human output of carbon dioxide. The fruits of their labour are healthy crops of dwarf wheat, lettuce and, most recently, soya beans. But the work still has a long way to go. In spacecraft of the future, they believe, a blooming plant growth facility would also recycle waste products for fertilisation – compost heaps in space? – as well as generating oxygen, absorbing airborne impurities and contributing to the water recovery system.

Once the crew is breathing easily and eating well, and all the hardware is ticking over perfectly, there comes a range of other considerations which are unique to an orbital lifestyle. For example, the surroundings. Anything that is a source of even the slightest irritation will add unnecessary stress which, over several months, could lead to major ructions within a crew. For that reason NASA has given interior design a very high priority: assessing interior colour schemes; finding ways to provide each astronaut with a maximum of privacy in their sleeping quarters; and shaping dining tables so that everyone faces one another.

At the Marshall Space Centre there is a full-scale mock-up of space station *Freedom*. Designers, engineers and astronauts check and recheck everything from the water pressure in the shower to the optimum tension of the vacuum-toilet restraining straps. The walls have velcro-fastened wallpaper, absorbent enough to soak up floating glob-

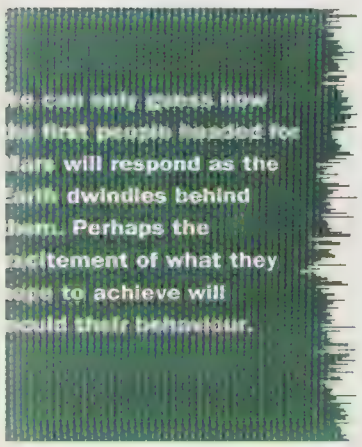


ules of spilt liquid. The ceilings are paler than the walls and floor so that astronauts in a weightless environment can still register which way is up.

Even after every minor domestic detail is addressed, there is one component of living in space that can't be overcome: weightlessness. For astronauts it is at once exhilarating and frustrating – imagine trying to eat a meal where everything floats away. But it can't be ignored. Because of its impact on the human body, zero gravity places more restraints on planning long missions than any other factor.

Our understanding of space medicine is remarkably limited. For information as fundamental as the body's energy requirements – how much oxygen is needed to perform basic weightless tasks like going outside the spacecraft to repair a solar panel – we can only guess at the answers. We know that on Earth the constant pull of gravity affects our sense of balance, the way our body moves, even our basic skeletal structure. Away from that gravitational pull, the body experiences a totally alien condition.

Experts can predict how weightlessness will affect a shuttle crew over a brief mission but, as Joe Sharp, the Director of Space Research at NASA's Ames Research Laboratory, points out: "Nobody has the foggiest idea of the effect of even 40 per cent of gravity over extended periods."



The most common ailment encountered by astronauts is space motion sickness. Known since the earliest flights, it's the first strange sensation your body feels as you leave gravity behind and enter space. You can sample that sensation here on earth by closing your eyes and nodding your head up and down as you spin in a rotating chair – not recommended straight after dinner.

The fortunate astronauts only feel mildly uncomfortable. But if one happens to be susceptible, then he or she may have episodes of repeated vomiting for three or four days. In one extreme case in the Soviet Salyut 6 missions, one cosmonaut was ill for 14 days.

In the US space shuttle programme, some 67 per cent of astronauts show symptoms and 13 per cent become severely ill. Why let these people fly at all? Because, unfortunately, space physicians are unable to tell in advance who will be susceptible.

NASA has recently announced a breakthrough in treatment. Physicians at the Johnson Space Centre in Houston say they have found an effective intramuscular drug which can be taken when someone feels ill – but obviously it would be better not to be sick in the first place.

At Ames Research Centre in California, physiologist Dr Patricia Cowings is trying to condition would-be astronauts not to get sick at all. Her course of treatment involves strapping the blindfolded subject into what is affectionately known as "the vomit chair" and spinning them. Anyone who can endure one hour spinning at 25 times a minute is cured. Speaking from personal experience (eight minutes in the chair), it's not my idea of fun. If this is what you have to endure on a shuttle mission I'd say that space isn't for everyone.

The consequences of prolonged weightlessness are of deep concern to space scientists. With no force to work against, the body becomes slack. Muscles atrophy in much the same way and cosmonauts have been known to lose up to 15 per cent of their bone tissue in six months. On a mission to Mars with no recourse to emergency medical aid, there's a chance that the loss of calcium excreted in the urine could lead to painful kidney stones and disable a crew member.

Because the heart doesn't have to pump so hard it becomes weaker and blood circulation becomes sluggish. As well, the volume of blood diminishes. These effects are now well documented and it's generally understood that a modified diet coupled with vigorous exercise can compensate for bone loss and muscle tone to some extent.

In theory an astronaut can stay in peak condition by spending at least four hours every day on a treadmill. In practice, cosmonauts returning to Earth's gravity after three months or more in space have experienced great difficulty standing upright. There are quite genuine fears that crew members on an 8-12 month voyage to Mars would fall flat on their faces when they tried to walk at their destination.

In Earth orbit, shuttles and space stations face the very real danger of collisions with space debris. Estimates put the amount of debris sized 1 cm or larger in excess of 30,000 pieces – and maybe as high as 70,000. If travelling at speed, even a tiny flake of paint from a spent rocket stage can pit windows, damage solar panels or, worse still, pass right through the suit of a space-walking astronaut.

Some indication of the risk of collision with man-made debris came from inspection of the Solar Max satellite, retrieved from orbit by the shuttle *Challenger* and returned to Earth. During its four years in space, Solar Max had sustained 331 debris impacts.

Experts calculate that during its projected 38-year operational lifespan, space station *Freedom* has a nearly 10 per cent chance of being severely damaged by collision with a large piece of debris (that is, a piece over ten centimetres across).

While astronauts remain in Earth orbit, they are largely protected from solar and cosmic radiation. Most charged particles are deflected by the Earth's powerful magnetic field, although enough get through to be of concern. How much of that radiation penetrates the human body has recently been the subject of a bizarre experiment. A human skull, encased in flesh-like plastic material has been a passenger

aboard three US shuttle missions. Hundreds of thermoluminescent dosimeters are embedded inside the "Phantom Head", as it's known, the idea being to record the radiation exposures at both skin and bone levels. NASA and the US Department of Defence plan to follow up by flying the torso of a human cadaver.

On the surface of the moon, or on a Mars mission, radiation is a much greater menace. In particular, astronauts would be vulnerable to heavy particle radiation which delivers a much greater biological hit than that encountered close to Earth. This sets a very difficult design challenge for the next generation of spaceships. If they sheath the vessel in protective metal, the total weight would be prohibitive. The current solution is to have a large compartment designated as a kind of storm retreat, its wall shielded from radiation not by heavy metals but by tanks of water. Of course whether such a strategy would be adequate is pure speculation. Until we send manned spacecraft out beyond the planet we have no way of being certain.

NASA life sciences expert, Dr Richard Keefe, believes that the selection of a crew for either space station or a longer mission is the single most difficult task they face. How many people is the right number? An equal number of men and women? What about married couples? What skill mix is best for a long voyage – do you need a physician, an engineer, an astronomer? Who should be the commander – or should there be one at all? Would a family arrangement be better, at least for handling housekeeping decisions?

So far only the longer Soviet space station missions have shown any evidence of psychological problems, and these only with small crews. One cosmonaut became mentally unstable, but on numerous occasions others have been understandably irritated, depressed or just simply bored. We can only guess how the first people headed for Mars will respond as the Earth dwindles behind them. Perhaps the excitement of what they hope to achieve will mould their behaviour.

Balanced against all of these problems is the enormous enthusiasm and energy of NASA and Glavcosmos. Both are determined to make it happen. For most of us the very idea of sending people to Mars within the next 30 years is almost audacious beyond belief – or foolhardy. Yet for American and Soviet planners that mission, more than any other, is an entree to an even bolder vision of the future – the first move towards a true space colony.

The space flights of the last three decades have never strayed far from Earth. Even the Apollo missions to the moon were firmly tied to mother Earth, and when disaster struck Apollo 13 the crew's only hope was to race back home.

The mission to Mars will finally break that tradition. The long voyage can only succeed if the crew is self-reliant. Once the spacecraft is on its way there will be no thought of rescue vessels, should the need arise.

Subsequent missions would establish the first permanent bases which would be sustained by regular supply drops from Earth. But at some time in the future those settlements would be able to fend for themselves: grow their own vegetables and build their own equipment. NASA already employs researchers to look at such long-term settlements. They are even seriously considering the "terra-forming" of Mars – creating of an artificial atmosphere and fertile soils in the image of Earth at its most pristine.

At the far end of the rainbow, a thousand years from now, there is a dream that the atmosphere of Mars will be air-like enough for us to freely breathe. By then the planet would have been settled for hundreds of years. The generations of humans born there would have grown up in a world with a substantially smaller gravitational pull than Earth, with the development of their vertebral column, hips and limbs no doubt reflecting that fact.

But by far the most dramatic aspect of such a scenario would be its independence from Earth. The apron strings would finally have been cut. Only then will people truly be able to say they are living in space – and not just visiting.

LIFE IN SPACE: A TIMETABLE

A timetable of some likely and less likely events in the manned and unmanned space calendar

November 1991: The SPEKTR add-on module will dock with the Soviet *Mir* space station, coinciding with *Mir*'s fifth anniversary of orbital operations.

1991/1992: Soviet cosmonaut Vasili Tsibliyev is scheduled to go to *Mir* on a new, ambitious mission lasting a year and a half. This is six months longer than the current world record of 366 days held by Titov and Manarov, and is an obvious training run for a manned mission to Mars.

1992: The Soviet Buran shuttle, which until now has only made pilotless flights, will make its first manned mission. It will probably dock with the *Mir* space station.

February 1992: The latest addition to the Soviet [illegible] launched.

July 1992: The European Space Agency's Giotto spacecraft, famous for its spectacular close encounter with Halley's Comet in March 1986, will encounter Comet Grigg Skjellerup. Currently over 100 million kilometres away, Giotto will be directed to "sling-shot" past Earth early in 1992 for its close fly-by of the comet.

September 1992: A Titan 111 rocket will launch NASA's Mars Observer robot spacecraft.

September 1993: NASA's robot Mars Observer will go into orbit around the red planet.

August 1994: The Ulysses probe will make its first polar orbit around the sun after completing its 4 year voyage from earth.

September 1994: The Soviets will send a pair of robot exploration probes to Mars. Each will feature inflatable balloons, 21 metres high, to carry their payloads of scientific instruments through the Martian atmosphere when they arrive there in October 1995. The balloon modules will also deploy four or five surface penetrators, titanium darts crammed with sensing devices that will be fired into the Martian soil.

1995: If Australia's Cape York Space Port goes ahead, early 1995 will see the first test launch. Glavcosmos has expressed interest in using the site to launch its new Zenith rockets.

1995/1997: The Soviet Union will launch *Mir* 2 atop the Energiya heavy-lifter rocket. It will be joined by several 100-tonne modules. It is envisaged that Russia's sixth space station will be busily involved in the semi-industrial production of semiconductors. For this purpose *Mir* 2 will have a great deal of electrical energy at its disposal – as much as 100 kilowatts (compared with Freedom's 75 kw).

March 1995: The assembly of space station *Freedom* begins.

Above: NASA'S Zero Prebreath Suit slated for use on the space station.The suit allows astronauts to avoid the three to four hours of prebreathing needed when going out into space with shuttle suits at standard cabin pressure.

The Galileo spacecraft launched in October 1989 will arrive at Jupiter – assuming it manages to complete its 28 course corrections en route.

The US laboratory module for space station *Freedom* to be launched.

NASA and the European Space Agency will launch the so-called Cassini mission. an unmanned planetary probe bound for Saturn.

A pressurised logistics module will be added to space station *Freedom*.

A four-person crew will be brought by shuttle to space station *Freedom*. From then on the station will have a permanent manned capability.

The NASA shuttle is due to carry up the European Space Agency's Columbus science module for attachment to *Freedom*.

Russia hopes to send a pair of robot probes, similar to the ill-fated Phobos probes, towards Mars. One would land on the moon Phobos, collect some soil and return to earth; the other would visit four or five large asteroids just beyond Mars's orbit.

Proposed Soviet mission to explore Mars using two intelligent robot vehicles. With stereo cameras for eyes; the plan is for each rover vehicle to cover about 150 km per year, exploring the Martian landscape and analysing its soils.

NASA plans to send a small armada of robot spacecraft to explore Mars.

The European Hermes spaceplane is scheduled to make its first manned space flights after three years of pilotless test flights.

Space station *Freedom* achieves operating capability status. This follows over 30 shuttle-based assembly missions.

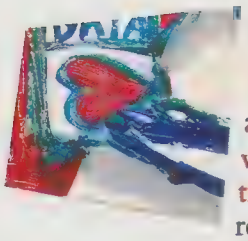
Cassini spacecraft due to arrive at Saturn. It will utilise the giant planet's gravity to ricochet past all of Saturn's major satellites, including the eighth moon only discovered recently. Of particular interest will be the planet-sized moon of Titan, the only other world besides Earth known to have a dense, nitrogen-rich atmosphere. On one of its flybys of Titan, Cassini will release a small probe (named Huygens) that will plunge into Titan's atmosphere and make a soft landing on the moon's surface.

If American plans for a manned mission to Mars were given an immediate go-ahead, and there were no technical delays between now and then, 2003 is the absolute earliest that the U.S. could attempt a manned mission. In that year, Mars and Earth will be about as close together as they can get, making the duration of the voyage a mere eight or nine months. If the mission is delayed until, say, 2011 when the planets are farther apart, the financial cost of the whole exercise could be two or three times as much. Some NASA officials suggest that 2020 is a more realistic date.

This is the earliest that the Soviets believe they can get a manned mission to Mars.

My hot da

WENDY HARMER goes on a date in '98 . . .



Angela checked her face in the mirror. Her amethyst-blue lenses blinked back at a slighly accelerated rate. A glance at her wrist readout told her it was true. Her heart, that perfectly conditioned and toned organ, was responding to external stimuli in a way it hadn't for some time. The rate was definitely way up.

Her lips were quivering too. She remembered horror stories of silicon wandering around the body. Synthetic beads turning nomadic and coagulating to give a pert breast in the small of the back. She wondered whether the collagen in her lips could leach out to other parts of her face. She could wander back into the bar with an Italian nose and lips two strands of twisted string.

A ridiculous thought; her mouth was still slightly numb from that morning's injections and her lips were full to bursting. A little extra care to make sure that she didn't dribble champagne down her chin and she was fine. A small smile touched her perfect Chanel No.52 pout.

"He is heaven," she mumbled to herself. "Please let him check out, please."

Angela flipped the pearlized cover on her Datamate, hesitated, then snapped it shut. "I could fly blind on this one," she thought. "Just see where the fates take me."

She knew she was stalling. Fate had dropped her here, 37 years old with a body clock on burn-out. Her friends had told her there were many trip-ups on the road to Nirvana, but Angela now had both knees heavily bandaged.

There was no room for chance any more and her Datamate subscription was the only way to head fate off at the pass. If she didn't log on now when would she log on? When they were sharing a candlelit supper, or worse, after the act itself? She shuddered and slapped the Datamate down on the metallic tiles of the vanity unit.

GOOD EVENING ANGELA.
9.15 PM, FEBRUARY 21, 1998,
the small unit winked into liquid crystal life.

"Good evening," Angela responded and then, as always, caught for a moment the absurdity of talking to what looked like a powder compact. She remembered with a wave of embarassment the evening she had whisked what she had thought was translucent maquillage de visage out of her bag to retouch her nose, only to be confronted by a digital readout. Early end to a beautiful evening. Tom had flounced out of the restaurant at the insult. Men had such fragile egos. Since then she had powdered her nose and done her research in the bathroom.

ROBERT AINSWORTH.

She hoped she had the spelling right.

ARCHITECT. 28 YEARS. RICHMOND.

Her ceramic nails tapped out as much information as she had been able to gather in the past hour.

SEARCHING.

How many 28-year-old architects named Robert Ainsworth in Richmond could there be?

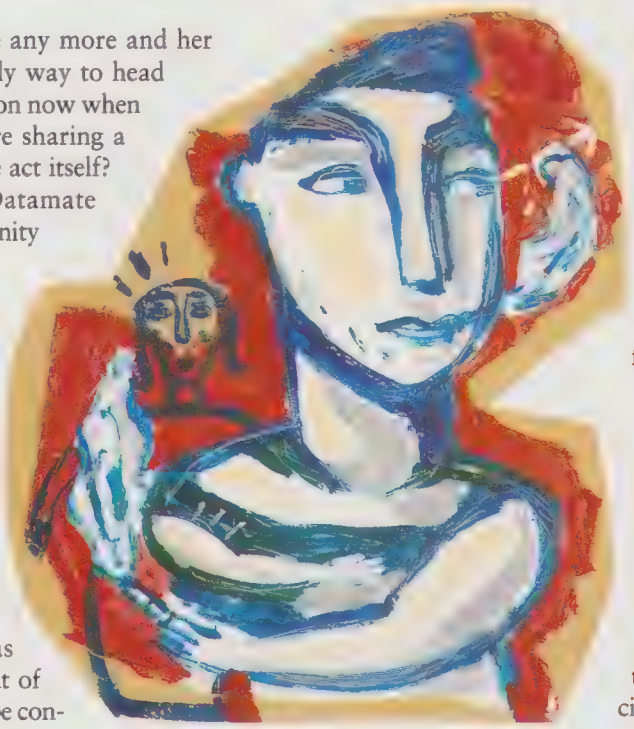
MORE INFORMATION PLEASE.

"You greedy thing," she breathed as she searched her mind for details. Much more of this and she would be able to apply for a job at the local CIB.

CHIN IMPLANT.

She had noticed the two small scars with approval. His face had a delicious and perfect symmetry. Tracing her mouth over that chin would be as exciting as scaling the Eiger.

Robert knew a Datamate subscriber when he saw one. Early thirties, professional woman with a cool interviewing technique which was a dead giveaway. If she'd offered him a cigarette and turned a 100w lamp in his face she couldn't have been less subtle. But he wanted Angela. Amethyst lenses and platinum light-fibre wig – he hadn't seen such a wild combination in years. He idly wondered about the real colour of her hair and eyes.



"I'll bet you $50 they're brown, Charlie," he said to the barman.

"You're on, Rob," replied Charlie who had won $50 last week on a brunette turned redhead.

Robert breathed into his blood-alcohol meter and ordered another vodka. His underwear crackled with a static charge, the combined effects, he supposed, of lycra body suit, pure rayon jacket and vinyl bar stool. He touched his feet to the rubber floor and his sleeves stopped humming.

Robert often dreamed of subscribing to Playdate. He'd seen the latest portable units – slimline, fluoro, waterproof sports models you could wear in the back pocket of track pants. They were very cute. Well, who knows when you're going to meet someone at the beach or the gym? And the evening models – monogrammed faux tortoiseshell like one of those old-fashioned cigarette cases. That was real class.

e with a datamate

"One day, Robert, you too will be earning that kind of money," he promised himself.

Angela obviously had that kind of money. But past that his powers of observation failed him. What else did she have? High powered paternity lawyers, sex case solicitors, or was she carrying something even more sinister?

He'd seen the Datamate unit in her bag and guessed she was logging on right now. She'd have the jump on him for at least 48 hours. It would be Monday morning before he could get to work and find some pretext to use the office computer. Then he could hack into the Playdate system and find out exactly what he was dealing with.

"Robert, you have 48 hours to keep that pulse rate racing for you. This is your mission, should you choose to accept it," he said, downing his vodka. It was a challenge. Robert put his hand to the recording device in his lapel to reassure himself.

"Friday, Angela, Mainframe bar," he identified the tape. He tried to remember exactly what information he'd fed about himself into the Datamate system and hoped he hadn't been too extravagant. He hoped Angela was going to pick up the tab for the champagne.

He thought he'd stop drinking so he could meet the challenge of Angela sober. Robert liked a challenge.

AINSWORTH R. 25 YEARS. ARCHITECT. RICHMOND.

Hmm, only 25, a little bit of cheating, but even better, thought Angela. Now what did she really want to know? Professional, financial, family, leisure, relationship/sexual details?

"Well, judging by my pulse rate, it's R/S this evening," she giggled. "Let's go."

RATING A1. HETEROSEXUAL. VIRGIN TO 17YRS. NSU TEST (15 AUG. 1995) — CLEAR. AIDS TEST (19 DEC. 1997) — CLEAR.RELATIONSHIPS: ROBIN CAMERON 1991-1994 (MARRIED); HELEN ANGELUCCHI 1995-1997 (*DE FACTO*). NO CHILDREN. SEXUAL PERFORMANCE RATING: N/A.

No performance rating? That was very odd. Angela was annoyed, what was the use in subscribing when the performance rating wasn't available? She was fully insured against performance failure, but it was a hassle. "Well, Angela, you used to like a little bit of mystery in a man," she told her reflection. Angela took one last look in the mirror, smoothing her rubberised mini-suit over her sleek hips and flicking her light fibre switch on. Now that she'd logged on she had a 48-hour cover note on the insurance policy. She'd have to go ahead with foreplay and then file more details to cover herself in the event of a claim.

"Because, Mr Ainsworth," she said as one small drop of bodily fluid slipped from the corner of her anaesthetized lips, "this is one modern trapeze artist who never swings without a net."

HAVE A NICE NIGHT.

The screen resolved to a grey fog.

"You look amazing," said Robert, his sleeves beginning to hum faintly again. "How about a coffee?"

"Well, actually, young man – and you are awfully young – I was thinking we should drink even more champagne ... back at my place," purred Angela, her light fibres casting a greenish hue over Robert's perfect chin.

Robert squirmed. It was going to be a long 48 hours.

TIM CLAEYS

250,000 births

There are too many of us and we are having too many children. **Solution:** better birth control. **Problems:** technology, religious beliefs, culture. **Prognosis:** bad

BY ANDREW WATERWORTH
Quantum

A quarter of a million people are born into the world every day. If that rate continues, the 1990s will see global population increase more than in any decade in history.

Even more alarming, the world's population – now 5.3 billion – is growing faster than experts have predicted. In 1984, demographers projected that it would stabilise at 10.2 billion by the end of the 21st century. Seven years later, the forecast is much gloomier. Because birth rates have not fallen as much as expected, United Nations officials have revised that figure by up to one billion.

But if fertility fails to slow down at the anticipated growth rate, we could be headed for a global population of up to14 billion by the end of the next century – almost three times the present number. An increase of this dimension could be catastrophic.

If the figures look bad, the imbalance within them is even more alarming. One-fifth of the world's population lives in poverty, while another quarter consumes three-quarters of the world's resources. This inequity is at the centre of the debate about population growth.

On one side there are the so-called neo-Malthusians, named after the 18th century English economist and demographer Thomas Malthus, who was best known for his theory that population will always tend to outstrip food supply – a "law" of inevitability, capable of being remedied only by strict limits on human reproduction. Advocates of this view argue for a policy of drastically curbing family size to avoid the human and ecological disaster of mass famines and waves of hunger-driven refugees.

The neo-Malthusian point of view is susceptible to accusations of racism since it concentrates on the population size and larger families of developing countries rather than the much higher per capita consumption rates of people in western industrialised countries. Opponents claim that population growth of itself is not the source of food shortages; rather poverty caused by a failure to distribute the world's food supplies equitably is the real culprit. The answer, they say, is political and economic change to land ownership, trade and the distribution of resources.

What are the options if we want to avoid an exponential growth in population and the disaster scenario that follows?

An attack on poverty, as the UN Population Fund suggests, is critical. If you raise people's living standards and improve their education, they tend to have smaller families. For example, the populations of Africa and Europe are presently the same – about 500 million each. But current forecasts suggest that in just 35 years, Africa's population will triple – depending partly on the impact of AIDS – while Europe's will remain much the same. In the short to medium term, birth control and family planning are going to be essential.

Nearly 50 per cent of the world's couples practise fertility control – but they do so with a limited array of methods, many of which have been around for twenty years or more. Why have science and technology failed to produce anything new since the oral contraceptive (the pill) was developed in 1951? The answer, while complex, can be summed up in two words – money and politics.

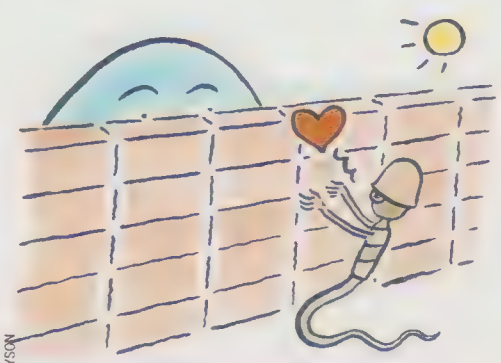
Large pharmaceutical companies have dedicated less money to contraception research and development over the past decade or more. Infertility and ageing have become the fashionable areas for research in response to the sensitive nature of birth control.

In the US, where pro-life lobby groups are particularly powerful, women now have fewer contraceptive choices than their counterparts in many third world countries – and the same is true of Australia. The new, lower-dose oral contraceptives for women available in Europe are not sold in Australia or the US.

Australian women don't have access to implants such as Norplant or vaginal rings, both of which work on the same principle as the pill; nor do they have the option of using the female condom, a vaginal sheath. This is despite claims that these alternatives offer safer methods of contraception for women.

The Soviet Union, Japan and the US, countries you might expect to be leaders in contraception, are amazingly backward. In the Soviet Union, which has the highest per capita abortion rate in the world, the pill is virtually unavailable. Japan has the third or fourth highest abortion rate and is the only industrialised nation where the pill is still not approved for contraceptive use. The US, meanwhile, has the highest teenage pregnancy and abortion rates of any industrialised country. What all this spells out very clearly is that there are too few choices when it comes to contraception.

In the absence of R & D by the pharmaceutical companies over the past two decades, the World Health Organisation (WHO) has been the major sponsor of research programs in contraception. Two of the most revolutionary and promising are the male contraceptive and the anti-fertility vaccine. Both have undergone initial clinical trials in several countries, including Australia.



Birth control: who uses what?

An estimated 400 million of the world's 900 million couples of reproductive age are estimated to use a contraceptive method. Of these, about 340 million use a modern method (sterilisation, pills, injectables, IUDs, condoms or spermicides). About 155 million rely on male or female sterilisation; 80 million use an IUD (58 million in China alone); 61 million use hormonal methods, primarily the pill (55 million); 38 million use condoms.

Traditional methods (rhythm; withdrawal) are used by about 58 million.

Fertility is also controlled by induced abortions. The total figure is hard to establish, but is estimated to be at least 30 million each year.

But sterilisation is by far the most widely practised method of contraception in the world, including both developed and developing countries.

THE MALE CONTRACEPTIVE

There are basically three choices for men: a vasectomy, condoms or coitus interruptus. Nearly 60 million men worldwide have had vasec-

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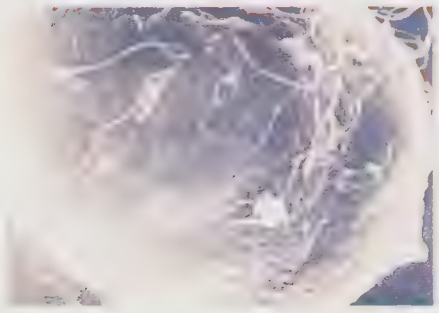


Sperm gathered on the "shell" of an egg prior to the penetration of one sperm for fertilisation.

Some stages in the development of a fertilised egg.

How the male contraceptive works

The aim of the male contraceptive is to reduce the sperm count to zero, rendering the male infertile.

The pituitary gland at the base of the brain secretes chemicals which activate pathways in the body leading to production of sperm in the testes. The testes then produce the male hormone, testosterone, which is responsible for inducing and maintaining secondary sex characteristics.

This hormone also acts as a feedback mechanism, regulating the pituitary gland secretions. By injecting a man with regular doses of testosterone, it should be possible to interfere with the system and fool the pituitary gland into believing that there were already sufficient supplies of testosterone, and therefore, no further need to activate sperm production.

tomies and some 40 million use condoms. But the breakthrough "male pill" has proved elusive.

A study published last year by the WHO Task Force on Methods for the Regulation of Male Fertility shows that reversible male contraception is possible. The technique is similar to that used in oral contraceptives for women. Instead of estrogen or progestogen, the male hormone testosterone is used to "fool" the body into supressing normal fertility.

Because testosterone is a sex hormone there is no loss of libido. In fact the extra quantities of the hormone can produce additional energy and muscle weight and, less appealingly, sometimes acne. Some doubt has been raised about possible long-term health risks in the form of prostate cancer, although there is insufficient data to draw firm conclusions about this aspect.

But it will be at least a decade before a safe, reversible male contraceptive is on the market.

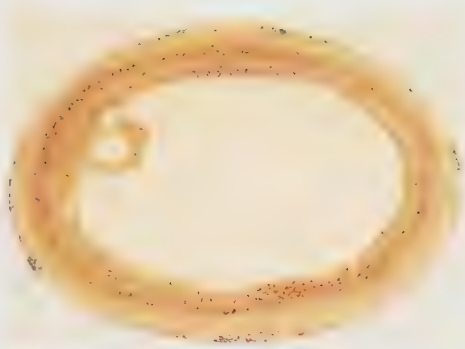
ANTI-FERTILITY VACCINE

The anti-fertility vaccine is a technique that could be applied to both men and women. The basic principle of the vaccine is to use the body's own immune system to control fertility. In women, the vaccine is directed against the pregnancy hormone, human chorionic gonadotropin (hCG), which allows the establishment of pregnancy by preparing the endometrium or lining of the uterus for the fertilised egg.

To make the vaccine, synthesised hCG is combined with the agent that causes the disease diphtheria. The body reacts to the hCG vaccine by developing antibodies to it. The result, in this case, is that the

body's defence mechanism is then on the alert for specific components of hCG and will attack them "on sight". The body will then target the pregnancy hormone (hCG) and by doing so, interrupt the sequence of events which leads to pregnancy, causing an apparently normal menstruation.

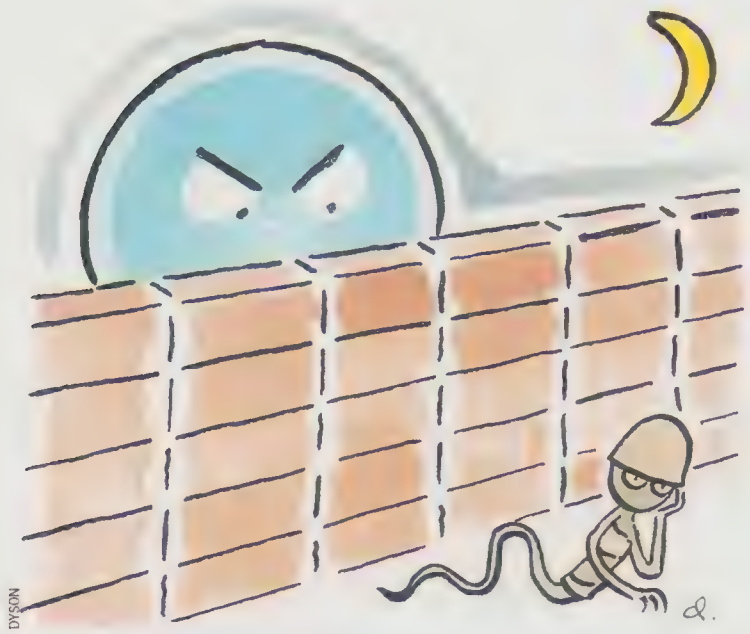
The advantages of a vaccine would be long-term birth control which could be renewed annually by means of a booster injection or, preferably, an oral dose. Unlike sterilisation, a vaccine allows for a return to fertility after the period of immunisation.



Egg developing in ovarian follicle prior to completion of maturation and ovulation.

Other possibilities being considered for birth control using a vaccine are immunising women against their own eggs or men against their own sperm. This would enable the vaccine to operate before fertilisation has taken place, making the procedure more acceptable to people with religious, cultural or ethical objections.

It's possible that vaccines could be in use in developing countries in five years' time. Because of stronger ethical constraints, it would be more like ten years before they become part of the developed world's lifestyle.



What is Norplant?

Norplant is a system which allows a slow, steady release of the hormone progestin into the body. The hormone is contained in six silicon tubes, each about the size of a match stick, which are implanted under the skin, usually in a woman's upper, inner arm. The implant, which can be carried out in a simple procedure taking 15 minutes, provides contraceptive protection for five years. The drug works by inhibiting ovulation and by thickening the cervical mucus, preventing sperm from reaching the eggs that are produced.

Norplant is highly effective against pregnancy, with a failure rate generally below one per cent at the end of the first year, and remaining low for the next four years.

Side effects are similar to those of other progestin-only contraceptives, principally irregular and prolonged bleeding; although these tend to subside over time.

Norplant is not recommended for women who may be pregnant, or who suffer from acute liver disease, jaundice, breast cancer, abnormal genital bleeding, thromboembolic disorders or thrombophlebitis, cerebral, vascular or coronary artery disease. A return to fertility can be achieved quickly once the implants are removed and the contraceptive effect wears off.

RU 486 – THE ANTI-ABORTION PILL

In 1980, scientists working for Roussel-Uclaf, a French pharmaceutical company based in Paris, were developing a range of synthesised steroids, artificially created versions of reproductive hormones such as progesterone, estrogen and testosterone. Almost by accident they discovered that the new synthesised hormone had an extraordinary capacity to block the action of progesterone, which plays a vital role in pregnancy.

Progesterone, produced by the corpus luteum during the menstrual cycle, causes the lining of the uterus, the endometrium, to thicken and prepare itself to nourish the embryo. A drug which blocked the actions of progesterone would have enormous potential as a contraceptive or abortifacient.

While few people like the idea of abortion, the reality is that at least 30 million women a year use this method of birth control – mainly because they lack the choice of contraceptives. Studies showed that RU 486, combined with an injection of prostaglandin – a chemical which causes a contraction of the uterus – was 96 per cent successful.

In 1988 Roussel-Uclaf won government approval to market RU 486 in France. The launch was greeted by a storm of protest from religious and anti-abortion groups who labelled the drug a "chemical attack" on the unborn and threatened to boycott all products of Hoechst, the West German parent company. Similar threats came from US lobbyists against the American subsidiary of Hoechst, which delivers 25 per cent of the parent company's profits. Hoechst executives bowed to the pressure and withdrew RU 486 from the market barely a month after its release.

At that point, however, the French government declared its interest; with a 36 per cent stake in Roussel-Uclaf, the government exercised its right under French law to tell the company that if it didn't resume production of RU 486 the patent would be transferred to someone else. The health minister, who issued the ultimatum, claimed that the drug was the moral property of women, not just the company. Two days later, RU 486 was back in production.

More than two years later, RU 486 is available in only two countries, France and China, and is being considered by health authorities in Britain. The major reason for its limited distribution is that Hoechst is reluctant to seek approval for marketing the drug more widely, given the potential for controversy. It is also reported that the Hoechst's chairman, a staunch Roman Catholic, is opposed to RU 486 on ethical grounds.

So far some 60,000 women have opted for the "abortion pill" in preference to a surgical abortion. The procedure itself is quite simple. The patient takes three pills which she must administer to herself, supervised by a clinic sister. Two days later, she returns to have the prostaglandin injection. In a small percentage of cases, the embryo will have already been aborted. But in most cases the abortion takes place at the clinic, within four hours of the injection.

The advantages of RU 486 for women are that it offers an alternative to the invasive procedure of surgery, the opportunity to feel more in control of the abortion and a reduced chance of infection or physical damage through surgery.

The disadvantages are that it is approved for use only during the first 49 days of pregnancy and that it may involve having to cope with the induced "miscarriage" at home. Short-term side-effects include bleeding from 1–35 days, generally around nine days. The drug is not suitable for women with suspected ectopic pregnancy, chronic adrenal failure, anaemia, any blood clotting disorder or in use of anti-coagulant therapy, long-term corticosteroid treatment, with kidney or liver failure or who are contra-indicated for synthetic prostaglandins.

Australian Space Office

SPACE – A FUTURE FOR AUSTRALIA?

For the second time in three decades Australia is poised on the threshold of space. The future realisation of high technology industry potential and our access to affordable space services demand that we act now to establish a viable space industry. Failing this we will become increasingly dependent on other countries to supply space services and hardware and will face escalating costs which could prevent us procuring data vital to primary industries and resource management or to satisfy our communications requirements. These factors aside, space probably offers the greatest conduit of any pursuit for developing high technology expertise and channelling it back into other applications. Accordingly, investment in space can lead to diverse benefits which can underpin and amplify national scientific, industrial and commercial capability.

TENTATIVE BEGINNINGS

Similar to our development as a nation founded from convict settlement, our first brief flirtation with space arose from opportunity seated in the perceptions of the British. Their original view that this huge, isolated, empty and remote island continent, made it "an ideal place" to create a prison colony, was replicated after World War II, when they saw it as "ideal" for atomic testing.

From the endowment of Woomera on 29 November 1967, following twenty years as host to an international testing program and with nuclear bombs giving way to rocket launches, Australia became just the third country in the world to launch its own satellite, WRESAT (Weapons Research Establishment Satellite), from its own soil.

Our adventure in space was short-lived, though, and with British and European interest moving from our shores, our fledgling space industry was soon to flounder for the want of support and funding. Like Sydney Cove, WRESAT was just the key to future opportunity, but unfortunately at that time, unlike our forebears, we failed to unlock the benefits, failed to pioneer the challenge.

HOPES FOR A SECOND CHANCE

Nearly twenty years after WRESAT the Australian Space Office (ASO) was established in 1987 within the Department of Industry, Technology and Commerce. The charter of the office was to formulate a National Space Programme, to develop internationally competitive space industries and to co-ordinate the delivery of space services of strategic national interest.

BUT WHY SPACE?

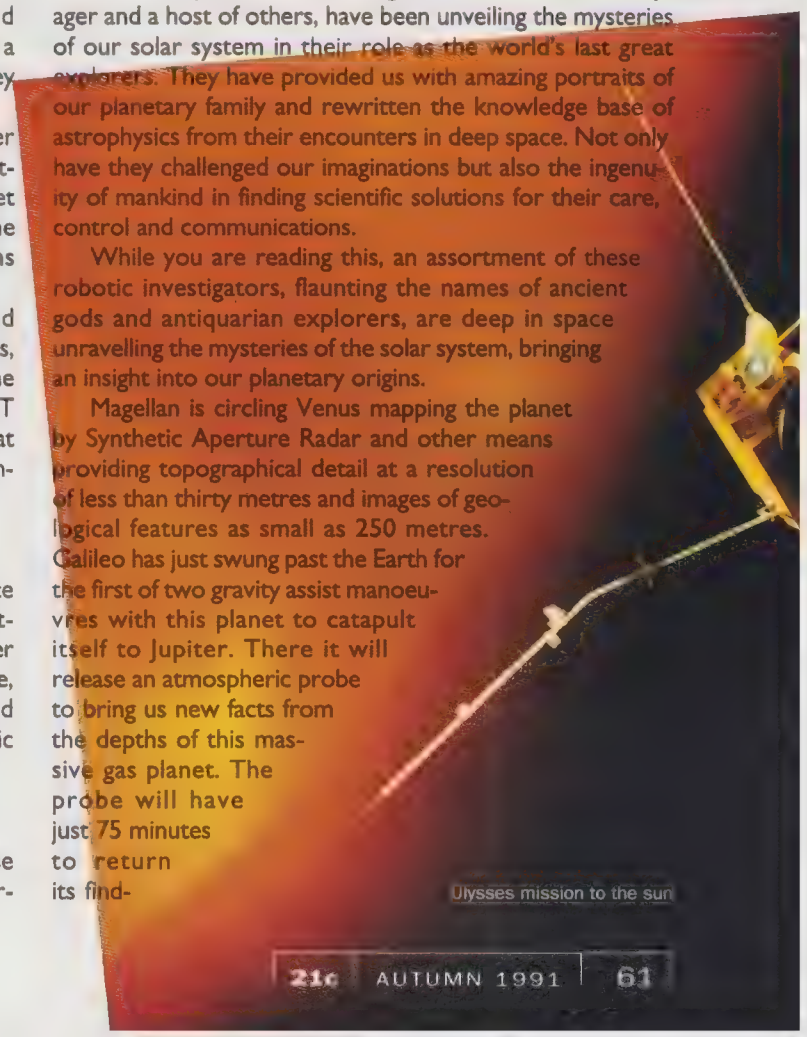
Daily, space touches all our lives, but few of us realise how dependent we have become on space-delivered services and the benefits these services bestow upon us. We take for granted direct access television coverage of world events, international telephone communications and the ubiquitous weather forecast. Many of us are probably unaware of maritime and aviation use of satellite-based global positioning and navigation systems and how remote sensing of Earth from space vitally influences life on this planet. From space-gathered data we can maintain and improve global habitability, monitor the global environment and study Earth processes. Australia is rich in natural resources for which space offers unique advantages in both fast and detailed exploration, mapping, observation and management solutions. These will apply particularly to mineral, agriculture and ocean resources. From the vantage point of space, phenomena such as greenhouse, ozone depletion, El Nino and global climate change can be accurately and continuously monitored.

EXTRA TERRESTRIALS

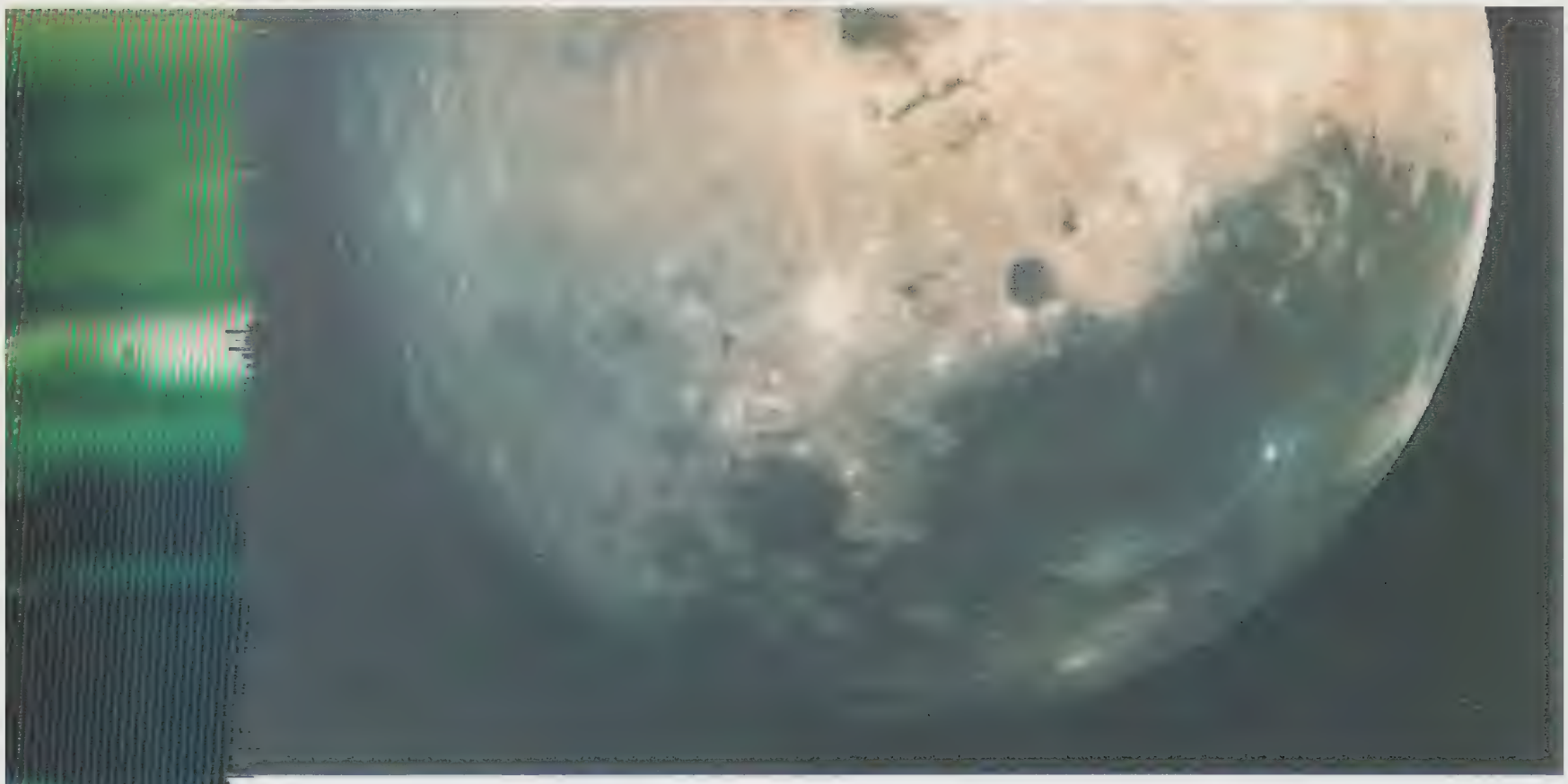
Robotic spacecraft like Ranger, Venera, Pioneer, Voyager and a host of others, have been unveiling the mysteries of our solar system in their role as the world's last great explorers. They have provided us with amazing portraits of our planetary family and rewritten the knowledge base of astrophysics from their encounters in deep space. Not only have they challenged our imaginations but also the ingenuity of mankind in finding scientific solutions for their care, control and communications.

While you are reading this, an assortment of these robotic investigators, flaunting the names of ancient gods and antiquarian explorers, are deep in space unravelling the mysteries of the solar system, bringing an insight into our planetary origins.

Magellan is circling Venus mapping the planet by Synthetic Aperture Radar and other means providing topographical detail at a resolution of less than thirty metres and images of geological features as small as 250 metres. Galileo has just swung past the Earth for the first of two gravity assist manoeuvres with this planet to catapult itself to Jupiter. There it will release an atmospheric probe to bring us new facts from the depths of this massive gas planet. The probe will have just 75 minutes to return its find-



Ulysses mission to the sun



The moon from 560.000 km. Photographed by the Galileo spacecraft

ings before being crushed by the force of the Jovian atmosphere. Ulysses is pioneering man's first visit to the Sun, using the immense gravity of the planet Jupiter to hurl the spacecraft out of the ecliptic plane – that plane in which the Earth orbits the Sun. Ulysses will bring a consortium of international scientists data on an entire set of complex interactions involving solar wind, cosmic rays and magnetic fields, which occur at the Sun's poles. Studies of these interactions have not been possible previously by other spacecraft or terrestrial-based observatories.

One of the most exciting and important of these missions is the forthcoming Mission to Planet Earth by NASA's EOS (Earth Observing System), which involves international collaboration on a grand scale. This space-based global observing system will provide absolutely unprecedented, broad and high resolution spectral and spatial data as well as long-term temporal coverage of the Earth. (See Summer 90-91 edition of 21•C "Previews of a Changing World", pp.46.)

Australia is directly involved in these programmes through the Canberra Deep Space Communication Complex which is managed by the Australian Space Office and operated entirely by Australian personnel, on behalf of NASA. The station forms part of the Deep Space Network and works with stations in Spain and the USA to span the globe. Australian scientists have also had a high level of involvement in science teams and as principal investigators for a number of the experiments performed in the remoteness of space.

ADVENT TECHNOLOGY

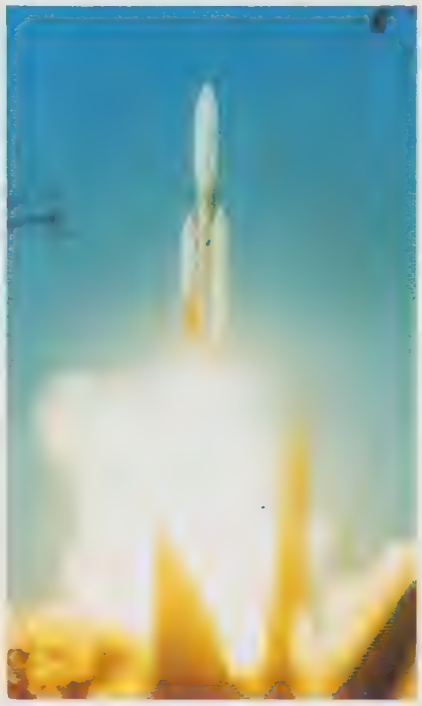
Out of programs such as these and the manned space missions have grown new technologies, technologies not just for space but for translation into our daily lives. Out of these technologies have developed new products, new industries – finding solutions to surviving in space gives inspiration for living better on Earth. Space technology is providing an endowment of quality to life.

In what is truly technology transfer, innovations from space technology have infiltrated almost every field of science and technology, stimulating secondary applications for these unique developments. These have become known as the "spin-offs" from space technology and include, among the 30,000 odd which now are generating new industries and enriching our lives, devices as mundane as Velcro, right through to Magnetic Resonance Diagnostic Imagers, revolutionising investigative medicine.

A whole new range of high-tech materials have been created for the space environment. These, such as some special lightweight high-strength alloys, have unique characteristics and real down-to-Earth applications. Nitinol, an alloy of nickel and titanium, is just one, and has bridged the gap from aerospace to orthodontics. Spin-offs have included cordless power tools, superglue, modern running shoes, scratch-resistant and ultraviolet light-filtering lens coatings, fire-resistant and high-strength fabrics like "GORETEX" and "KEVLAR", insulin infusion pumps, light-weight self-contained breathing apparatus ... the list goes on!

BUT WHAT OF THE FUTURE?

True space is a unique environment free from the gravitational forces which affect every living and inanimate object on Earth. The force of gravity extends far beyond the surface of Earth and even at altitudes of over 300 kilometres its value is virtually unchanged from that at sea level. However, if a body is held in low Earth orbit by a high tangential velocity, a microgravity environment can be created whereby the force on the spacecraft is reduced to one ten-thousandth that of gravity.



Liftoff for the Jupiter spacecraft

Microgravity environments offer unique conditions for long-duration experiments and the manufacture of rare materials. The absence of gravity permits materials to be created as perfect mixtures of uniformly distributed molecules. Extraordinary yields and sizes occur in protein crystals grown in the microgravity environment of space compared with those created in reference experiments on Earth. Study of their molecular structure by diffraction X-ray techniques facilitates their synthesis in Earth-based laboratories. Strong and durable alloys, high-purity pharmaceuticals, and semiconductors with far fewer imperfections than those produced on Earth are but a few examples of the benefits of space-based manufacturing. The application of technologies pioneered in space may well refine products produced on Earth.

At present there are a number of international programmes for the development of space stations. Because of the immense commercial benefits,

entrepreneurs from the pharmaceutical, chemical, ceramics, computing and telecommunications industries are expected to realise the commercial potential of space-based manufacturing and quickly establish a foothold in space. Manned space stations also offer the prospect of life-science studies which will surely advance medicine and improve our health and life on Earth.

A SPACE PROGRAMME FOR AUSTRALIA

The Australian Space Office carries the tag-line "Making Space for Australia", and is setting about just that – by backing Australian initiatives to develop a credible space capability and to realise the national strategic economic benefits that space affords.

Since its inception the office has been involved in reviewing science and industry activities, determining opportunities, developing a national space policy (underpined by industry strategies and action plans) and fulfilling a leadership and co-ordination role for the scientific, commercial, industrial and international space activities pursued by disparate interests within Australia. The ASO also supports the government-appointed Australian Space Board, which fulfils an advisory role in the formulation of the national space policy, and has working partnerships with CSIRO, ACRES and other government instrumentalities. Most importantly, the office works closely with our fledgling space industry.

The Australian Space Office is stimulating Australian space activity by providing public funding to a range of projects which will allow Australia to establish a foothold in space and to establish a credibility from which greater participation in international projects can take place. Space demands the highest levels of quality assurance and only space-qualified products are acceptable internationally, as an insurance against failure.

AUSTRALIAN SPACE PROJECTS

Although Australia had no definitive national space programme throughout the 1970's and early 1980's, there were ongoing space activities within Australia. The CSIRO and several universities continued to undertake basic and applied research in a range of disciplines with space applications, particularly astrophysics, aerodynamics, instrumentation and image interpretation. Similarly, international satellite-based telecommunications flourished with the introduction of the domestic communications satellite, AUSSAT, servicing Australia and nearby countries.

Research institutions and some private companies established international recognition for particular expertise. In hypersonic research and testing applications (pioneered at the Australian National University and later the University of Queensland by Professor Ray Stalker, et al) Australia is the acknowledged world leader.

This work has been advanced independently by private enterprise and until recently made Australia the sole supplier of free-piston shock tunnels capable of testing spacecraft under simulated flight conditions. The company, WBM.STALKER, is now collaborating with the University of Queensland in the development of a supersonic combustion ramjet (SCRAMJET) which has application in future space transportation systems.

Unique instrumentation capabilities and sensors were developed from Stalker's research, and through this expertise Australia is now embarking on the development of a spacecraft-borne, Re-entry Air Data System (READS), under a project sponsored by the Australian Space Office.

Through LANDSAT and later the Australian Centre for Remote Sensing (ACRES) Australia has developed an acknowledged capability in remote sensing applications. Under the ASO's International Program remote sensing expertise is now being delivered to neighbouring countries in Asia and the Pacific by Australian companies, with the prospect of fully commercial projects in the future.

PROPOSAL FOR A SPACE PORT

Since the inception of the National Space Program the one project which has excited public interest more than any other is the Cape York Space Port. This private-enterprise proposal would permit Australia to offer the first truly commercial space vehicle launch facility in the world. In terms of this launch site, Australia is indeed "the lucky country", with the benefits of proximity to the equator making a perfect location for placing spacecraft into geostationary equatorial orbit with payload-to-thrust advantages giving clear competitive commercial benefits.

Simply put, larger payloads can be launched from Cape York with equivalent launch vehicles than from most exiting or known, proposed international launch sites. Add to this, Australia's political stability, sound international relationships, holistic infrastructure support and favourable climate and the attractiveness of the project becomes self-evident. Apart from that, the project has been described as the single most important industrial development in Australia's history. Clearly the project is of great national import; one having the potential to deliver benefits on a national level far beyond those immediately isolated to the operation of a spaceport.

WOOMERA REVISITED

Other Australian companies are also looking towards reinvigorating Woomera as a launch site, through the development of an Australian launch vehicle which would fill a niche in the payload capacities of overseas launch vehicles. The company is seeking to launch satellites for the US-based Motorola company's Iridium Project, an innovative concept which will place 77 small (80 kilogram) satellites into low-Earth orbit for a global mobile communications network.

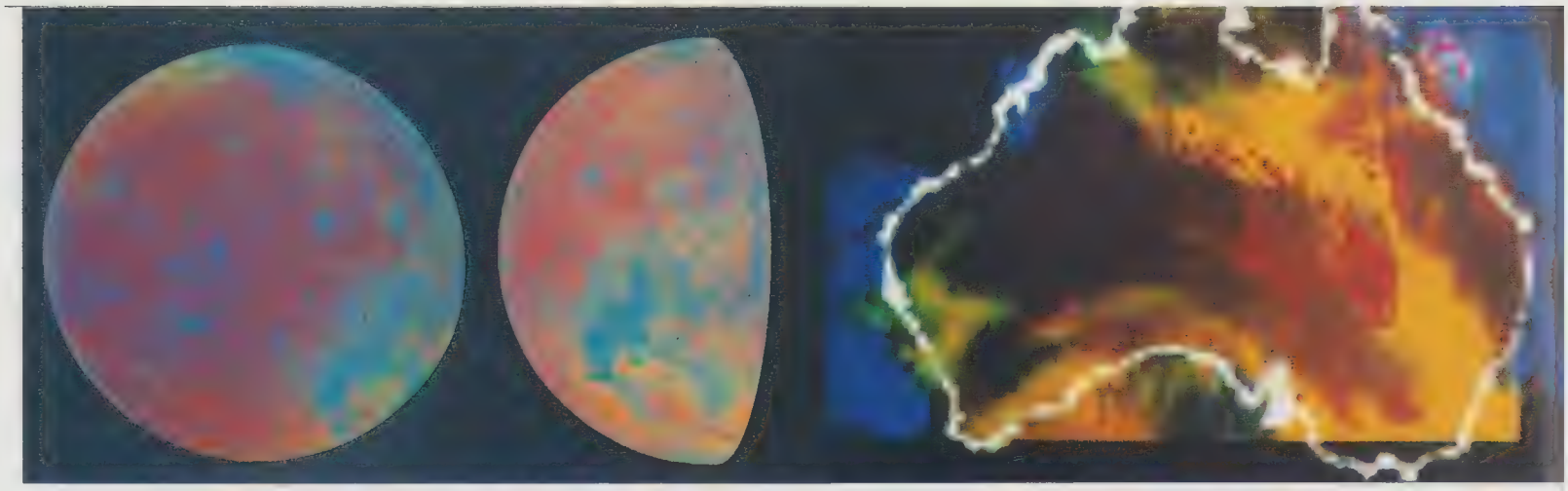
RUSSIAN COLLABORATION

Space offers great opportunities for international collaboration and in the case of project "Radioastron" has permitted close co-operation with the USSR. Radioastron is aimed at simulating a huge radiotelescope by coupling Earth-base and orbiting receivers. Australian participation in the project was backed by the ASO under its international programme involving joint funding with the CSIRO for the development and manufacture of an L-Band receiver for the orbiting Soviet radiotelescope.

An artist's impression of the Galileo orbiter encountering Io

ENDEAVOUR

Australian participation in the American Starlab programme of the 1970's led to the development of Endeavour, an ultraviolet telescope conceptualised, designed and manufactured in Australia and due to fly on a Shuttle mission in mid-1991. This project has received almost $4,000,000 in ASO funding and has created indigenous expertise with-



Visualisations of the moon depicting the composition or weathering of surface materials

A multispectral map of Australia taken by the Galileo spacecraft 80,000 Km

in Australian companies in a range of disciplines, including: design, development, quality assurance and manufacturing. Endeavour is set to become Australia's first complete space-qualified payload since WRESAT. This is a significant milestone towards future space industry opportunity.

STIMULATING R & D

One initiative of the ASO has been the creation of "centres of excellence" under the Space Industry Development Centre concept which encourages research and development collaboration by industrial and research enterprises in a 50/50 funding partnership with the ASO. One such centre based in Adelaide.

The Australian Space Centre for Signal Processing, is the largest Digital Signal Processing resource outside Europe and the USA. The Centre is pursuing a number of projects, including: high-speed digital Earth stations for communicating with satellites, with associated research into very high bit rate terminals; mobile satellite communications terminals; remotely controlled and monitored telemetry systems for satellite ground stations; and, in an innovative approach to the problems of space debris, development of highly sophisticated software to calculate the probability of collisions between orbital debris and spacecraft.

IMPROVED REMOTE SENSING

The European Space Agency's Earth Resource Satellite-1 (ERS-1) is due for launch in May 1991. In readiness to access data from the craft and to maintain Australian remote-sensing capability, an upgrade of the ACRES facilities is being undertaken. This involves the installation of a Fast Delivery Processor which will provide 1/10 real time, high bit rate, data processing.

An associated project is the recently funded Tasmanian Earth Resources Satellite Station (TERSS) which is the first facility in a planned network of low-cost Australian developed satellite reception stations, employing state of the art technology. The station will acquire and process data enabling a better understanding of complex world climate interactions and will provide information for fishing, commercial shipping and Antarctic operations. The facility's ability to receive X and S-Band transmissions from next generation Synthetic Aperture Radar satellites is important to improved oceanography.

When the European ERS-1 is launched this year, it will be carrying Australian conceived and produced technology to improve weather forecasting by measuring sea surface temperatures. This will be achieved with highly accurate instrumentation known as the Along Track Scanning Radiometer (ATSR) to which Australia has made a major intellectual contribution through the work of Dr Ian Barton, of the CSIRO Division of Atmospheric Research. ATSR will incorporate, under funding from the Australian Space Office, an $850,000 Digital Electronics Unit to undertake ERS-1 onboard data processing. The unit was built by British Aerospace Australia and contributes to our inventory of "space-qualified" hardware. Australian collaboration with Europe is continuing through the follow-on, ATSR-2 project, which, apart from carrying an infra-red sensor like its predecessor, will be equipped with optical sensing channels. The heart of the optical system is an infrared focal plane assembly, and this, together with electrical ground support equipment (required for extensive pre-launch ground testing and calibration) is being supplied by Australian industry under contracts with the Australian Space Office. Australian participation in the next generation of the equipment, the Advanced Along Track Scanning Radiometer (AATSR), which is to fly on the European Polar Platform late this decade, is under present consideration.

A technically simple, passive remote sensing instrument which uses high resolution spectographic analysis of sunlight absorption by oxygen, is another product demonstrating Australian ingenuity. The device known as the Atmospheric Pressure Sensor (APS) was conceived, designed and developed by the CSIRO. The instrument will improve meteorological forecasting over sea and remote land areas by enabling the measurement of the atmospheric pressure at the Earth's surface from an orbiting satellite platform. A laboratory model of the APS has been built and the concept proven by flight test.

CREATING A FUTURE

Few would dispute that Australians have made a innovative contribution to almost every field of endeavour pursued by this young nation at a scientific, industrial, commercial and competitive level. We have demonstrably been a "Clever Country" and one that has been willing to compete and contribute internationally. The main difficulty with the clever country equation for success, though, is that it is one which demands support and commitment. Without appropriate levels of involvement by commercial enterprise, coupled with a determination to reap the benefits of an indigenous space programme, the chances of success are small.

Given reasonable opportunity to participate, space represents a great new frontier with almost limitless prospects for exploitation.

For a second time we are on the fringe of a national space programme and contemplating the challenge. Given reasonable opportunity to participate, space represents a great new frontier with almost limitless prospects for exploitation. Here is a 21st-century arena in which to establish a whole new ballgame for Australia.

We already have the players – Australian tertiary institutions are turning out graduates in space and associated disciplines who form a pool of expertise ready to be tapped. Already, clever Australians have established niches in a whole range of space specialisations. Visionaries will quickly identify international opportunities. Australian, "winged-keel" type, innovation could well see us sailing to the forefront as true winners from space technology.

The Australian Space Office is dedicated to the creation of a positive environment within which the many benefits of space can proliferate and flow to the Australian community. We have but a window of opportunity – our research community is skilled and enjoys international respect, our companies have developed capabilities and our space activities are gaining significant momentum. Time will tell whether the 21st century will identify Australians among the true beneficiaries of space technology or as being dependent on international benevolence for the acquisition of space services.

Coming: the Australian Republic

Australia must cast off its monarchical trappings and move forward into the future with a new identity; a future which will give its highest priority to maintaining the quality of the human life, writes NSW Supreme Court Judge, KEPPEL ENDERBY

KEPPEL ENDERBY

Within 20 years I would expect and hope that Australia has discarded its monarchical trappings and become a republic: a proud Republic of Australia which would conduct itself with dignity as a member of the international community, without the present confusion that results from its being a kingdom with a queen who is monarch of another country.

I would like to see us with a completely different constitution which reflects a new identity. It would contain a statement of values and, consistent with those values, a Bill of Rights.

There would be no states or territories. They are completely artificial and the result of historical accident. They give rise to conflicting power relationships in our public sector, and contend against each other and weaken that sector. I do not believe that small government is better than big government, and that a smaller public sector should yield to a bigger, stronger private sector. Each should balance the other, and for there to be balance, the public sector has to be big.

The constitution I would hope to see would provide for a two-tier system of government, rather than a three-tier system, with a much larger national parliament and many much larger regional or local parliaments.

I would prefer to see a single system of Australian law and justice. This is consistent with my preference for a single, unified Australian state instead of a federation. I see no point in the present hotch-potch of state fiefdoms.

Today the legal profession in Australia has become so powerful that it increasingly and successfully challenges any attempt by government to reform and improve our systems of justice.

But the biggest constraint on freedom and liberty is not state power, state regulations, nor the criminal law, but necessity. The restrictions and limitations imposed by necessity, poverty and lack of opportunity are far greater from an individual's point of view than those imposed by the State.

In countries like Australia young people who share a feeling of frustration about being unable to enjoy the good things in life resort to escape routes such as drugs. Those who do manage to succeed also resort to drugs because of the pressures and strains imposed on them.

I do not forsee an Australia without corruption or crime; the price to be paid, in terms of loss of civil liberties, would not be worth that. The great majority of Australians, however, would be honest and law-abiding, not through the operation of the criminal law and the goals and the principles of deterrence, but through education and good will. Our jails would be recognised for what they are — breeding places of crime and degradation and places not necessary except for a very small percentage of already hardened criminals. Even for them, the conditions would be improved.

In 1991, many categories of inequality still abound. They result, not from the market forces, but from status. Women remain disadvantaged, but hopefully that disadvantage will be gone, or at least substantially reduced, by 2011. In the same vein, hopefully the national disgrace that attaches to all of us because of the way we permit, and in many cases require, our Aboriginal people to live, will have ceased. As far as possible, the justifiable grievances of black Australians will have been removed.

I hope that in 20 years' time the Accord between governments and the ACTU, or some variation of it, will still be in operation. I do not want to see a return to a law of the jungle as once existed in the field of industrial relations.

It was a great step forward in Australia when industrial relations became "a new province for law and order". Our centralised wage fixing system should continue to exist, but in an improved form. With all its faults, it still works against, and holds in check, the greater escalation in the difference between rich and poor that I believe greater reliance on market forces would produce.

I would see Australia 20 years hence having a much greater population than now. In terms of equity with the peoples of the rest of the world, there is no reason why the entire east coast of Australia, from Cape York to Tasmania inland for 500 miles, could not support perhaps 60-70 million people.

It is true, if that were to happen, that it would make little difference to the over-population that exists in other countries like Indonesia and in parts of India and China. But at least it would allow Australians to claim with justice that they are not "hogging" all this wealth to themselves and excluding others from it.

'The entire east coast of Australia could support a population of 60–70 million people'

I would hope to see much less money spent on defence. I can see no point at all in the hundreds of millions of dollars that are wasted on so-called defence expenditures. The very substantial savings would be available for more deserving purposes, such as education, social services, housing, roads, the environment, the creation of a safety net for the old, the ill, the infirm and the unemployed, assistance to the arts and culture, and the provision of a better comprehensive national health scheme.

Science would be encouraged and facilities provided for all forms of research. Bodies like the CSIRO should be expanded and more adequately funded. Science is the one certain lever capable of raising us to higher levels and standards of living. The glory of science is that it can free the soul, break the mental manacles and get the brain out of bondage. It gives courage to thought.

Public broadcasters such as the ABC and SBS would flourish. I do not have to repeat the arguments about public enterprise which I have set out above.

Human life, indeed all life, is extremely precious, and the Australia of 20 years' time would give its highest priority to maintaining the quality of the human life. In all this, and from all of this, the individual, as an individual, would emerge and be valued above all else.

Dinnertime 2000

Our fruit and vegetables will contain fewer chemicals. Our fish will be fresher and better-textured. Gene technology will deliver us the reddest tomatoes we desire. But no amount of purifying technology will make Australians eat better food if their instincts don't lead them to it.
STEPHANIE ALEXANDER, restaurateur and food lover, provides a personal view of our food future

Once on a stony Greek beach a small girl came to stare at me. We did not share any language. She had shiny black hair, pink cheeks and was a picture of health and happiness. She was rapturously crunching on a cucumber.

At the time I mused on the cultural differences that made one child ecstatic about a cucumber, whereas in our own community it probably would have been a frozen confection on a stick. This difference in attitude is the distance we still have to travel before embracing the food part of our lives as wholeheartedly and sensuously as do non-Anglo Saxons.

Whether we will travel that distance by the beginning of the next century is debatable. Certainly it will be a less bumpy road than in the past. Our food will be purer: over the next decade Australian-grown food will be less likely to have dangerous levels of chemical or heavy metal residues. The pressures of the marketplace will need to see to this. Farmers make economic decisions and will respond with "clean" food and environmentally sound farming practices if it makes good economic sense in the short and long term. A discriminating marketplace could create demands for clean, fresh foods and show it is not prepared to accept otherwise.

Households and commercial orchards will both be managing their organic waste. Agriculture will continue to move towards minimal use of chemical sprays. Using natural predators and companion plantings will no longer be seen of interest only to the alternative gardener.

As our waters hopefully become less polluted, fish numbers will increase. Research will have resulted in technological advances that are environmentally friendly. Fishermen will be required to use nets that no longer mash small fish into a useless and wasteful pulp. Scallop fishermen will be able to harvest from Port Phillip Bay using dredging machinery that does not scour the ocean floor, damaging everything in its path. New techniques of handling fish on board boats that have to remain out at sea for several days will make fresher and better-textured fish available to more of the population. Such techniques include speedy removal of the blood line of the fish and prolonging rigor mortis by the use of ice slurries.

Industry bodies will be convinced of the value of such research and development. Research will increasingly be funded by contributions from each and every producer. The involvement of the industry will result in voluntary controls, checks and balances being willingly agreed to and rigorously policed. More Australians now realise that the bounty of the earth is not inexhaustible, certainly not if wasteful and blindly greedy agricultural practices are permitted. They will look back on some of the practices common in the eighties and shudder.

Among Australia's advantages over its international competitors in producing "clean" foods are: an absence of radioactive pollution; a low level of chemical pollution; its ability to repair environmental damage at relatively low cost; and, of course, its climate and abundant land.

More and more commentators from the rebellious, grimy, traffic-ridden cities of Europe will have visited and written glowing accounts. We will finally give up the cringe. Our wines, our meats, our fresh produce arriving out-of-season in northern markets will spread the word further.

To successfully compete in world markets with Chile and Argentina has presented huge challenges for Australian food producers. Practices not deemed efficient will be in danger of disappearing forever. Some we will be happy to lose, but we will have to be on guard about some others. If market forces decree that we will only eat red, hard and shiny apples, it will take persistent and articulate opposition from consumers to prevent the disappearance of striped golden and red ones.

The consumer will be more confident of his or her power to determine what is grown. Growers and manufacturers will have realised that they must produce what the public wants to eat rather than impose products on a passive audience. They will also understand that successful and efficient niche marketing can deliver viability. Gene technology will be better understood, and not be dismissed as interfering with nature. The technology has been with us forever; it is a matter of deciding what characteristics one would like in a tomato, and it can be done.

Consumer awareness can be influenced by responsible and intelligent food journalism. Convenience and pre-packaged foods will continue to proliferate. Manufacturers realise that consumers now read labels. Food additives and residues will continue to be vociferously discussed and generally community attitudes are to be suspicious of them all.

In a thought-provoking and spirited attack on a publication *Diet For a Poisoned Planet* by David Steinman (Harmony Books, New York, 1990), Professor Bruce Ames of the University of California at Berkeley, Professor of Biochemistry and Molecular Biology, writes in the December/January Newsletter of the American Food and Wine Society and cautions against confusing correlation and cause-and-effect and of pseudo-science. He states: "Americans eat about 1.5 grams of natural pesticides per person per day – about 10,000 times more than they eat of synthetic pesticides. Although less than one per cent of natural pesticides have been tested for carcinogenicity, about half of those tested are carcinogenic to rats or mice. Natural rodent 'carcinogens' have been detected in numerous fruits, vegetables, herbs and spices, including apple, banana, basil, broccoli, cabbage, carrot, cauliflower, celery, cherry, cinnamon, cloves..." (I will stop at the C's!). This important article concludes that *Diet For a Poisoned Planet* could well poison many minds, unnecessarily scaring people from eating affordable, nutritious foods, which are partly responsible for our constantly increasing life expectancy.

Conclusion: we must constantly be on guard against pseudo-scientific and alarmist pronouncements in the media.

More of the same seems likely for the many consumers yet to be convinced of the benefits of good food. Fish fingers made from frozen, minced and pressed imported fish will still represent the greatest percentage of fish eaten in the country. Average quality will still be the aim of most manufacturers. Price and durability will remain as the major selection criteria for many. Supermarket frozen food counters will become even larger and carry more diverse items; every home will probably have a microwave oven. But alongside the reality that fewer families seem to regard sharing around a table as one of life's greatest pleasures, to be enjoyed each evening, are the hopeful signs that a significant minority do care for their food, its methods of production and its flavour.

My personal mission is to do whatever I can to excite as many people as possible to the delights and glories of good food. This involves offering them tasty dishes at my restaurant. It involves initiating as many young cooks and students as I can to the more passionate aspects of choosing and preparing food. It also involves endlessly talking and enthusing about high-quality ingredients. It involves identifiying those in the community who do care and who put their care and concern into action, growing and offering for sale products that are delicious and the best of their kind.

Food lovers have a responsibility to support these people. They should seek out such products, ask for them by name at their supermarket. The protestations of the well-travelled and well-heeled that food is so much more wonderful in Europe need to be challenged at every utterance. Excellent flavours are all around them here. If they thought more carefully before automatically reaching for the imported cheese, or the imported vinegar, or the imported pickle and supported the Australian product he or she would be making a positive move towards a stronger consumer base for these small producers.

Hopefully there will be more food writing that focuses on the social and cultural interest in what the world eats rather than voyeuristic accounts of the he ate/she ate variety. Our third and fourth generation of migrants will proudly promote their own food traditions and all Australians will continue to benefit from the magnificent range of authentic flavours produced by our Greek, Lebanese, Chinese, Italian, Turkish, Indian and Vietnamese cooks.

Lucky Anglo-Saxons will be those who have migrants for friends. They have some hope of ridding themselves of the terrible British legacy of puritanism that suggested that to equate a wonderful meal with pleasure was almost a sin. More of us will lick our fingertips, suck at sweet bones and mop up oily plates with good bread than ever before.

A bit of wishful thinking would be to hope that everyone would grow some food sometime in their life. One pot of basil has meaning and significance beyond the aroma it gives to the oil and tomatoes. It represents the mystery of life. As one watches the plant moving from infancy to maturity, needing care and protection from frosts and snails, one feels grateful for the pleasure each leaf brings all through the summer and then after flowering as the leaves start to yellow, one must be quick to make the last jar of pesto to store for the winter months ahead.

As well as growing food, one should cook. Women still have the nurturing role in most households. They daily show their love for their family by peeling, slicing, kneading, stirring and baking. My mother taught me to cook from the time I was five years old. As I progressed from scraping the basin, to peeling the apples, to being asked to choose the pudding I learnt to appreciate what love and care is baked into every pie.

Of course there are bad things happening – food technology regularly invents some abominations. There are plenty of commentators who seem to enjoy nothing better than to focus on such things. Whilst they concentrate on the ersatz and the substitutes, those producing the best wither through lack of support.

Excuse me, sir, there's an adulteration in your soup

Our foods have nearly always been adulterated or contaminated in some way. Now there is a trend towards cleaner food – and hopefully improved health

In the good old days – the days before agribusiness, chemical sprays or technology – food was, more often than not, pretty bloody awful. In the distant past our hunting fathers threw their prey onto hot coals to cook, taking charcoal and minerals into their diet. Later on, toxic minerals permeated the meat when it was smoked.

In the days before canning and refrigeration, the need to preserve food – or to disguise the flavour of food that was going off – was one of the major reasons for contaminating it with mustard, pepper or impure salt. Sometimes additives were used, as they are now, to make food look better; the disturbing practice of cooking gherkins in vinegar in copper vessels to give them a bright green colour is very old indeed.

Then, of course, there was shonkiness: Roman wine was adulterated with marble and lime, Roman bread was whitened with powdered alum (although Turkish bread wasn't, because of the penalty: nailing the culprit's ear to the baker's door).

Things got so bad that, by the Middle Ages, European bread had become a serious problem. It was flavoured with coriander, anise, cumin, sesame-seed oil, even with poppy seeds and hemp seeds. Sometimes it was contaminated with ergot, the hallucinogenic fungus from which LSD is derived. The result, according to the Italian historian Piero Camporesi, was that you could actually get high on medieval bread. It was the drug of the poor, arousing strange dreams and sending its victims dancing frenetically into the streets and fields.

Centuries later bread was still being whitened with alum, as the English chemist Frederick Accum revealed in his Treatise on the Adulteration of Food and Culinary Poisons, published in 1820. "Indeed," wrote Accum, "it would be difficult to mention a single article of food which is not to be met with in an adulterated state and there are some substances which are scarcely ever to be procured genuine."

The growth of cultivation, on the other hand, has also meant that some foods have gradually become healthier than they would have been if left in their natural state.

Most plants don't want to be eaten, which is why they have developed a powerful arsenal of chemical defences. But in many cases – for example, potatoes, lima beans and cabbage – domestication has given us breeds that are safe to eat.

It is important to distinguish between additives and contaminants. A contaminant is essentially an additive that nobody asked for. According to the Codex Alimentarius Commission, the international policing body of food standards, a contaminant is "any substance not intentionally added to food, which is present in such food as a result of production, manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food or as a result of environmental contamination."

A pesticide residue still clinging to the leaves of your lettuce is a contaminant. So is an antibiotic that has worked its way from the animal's feed to the animal's gut and from the animal's gut to yours.

An additive, meanwhile, is defined as "any substance not normally consumed as a food by itself and not normally used as a typical ingredient of food" which is deliberately added to the food in such a way as to affect its characteristics.

Some additives still serve the age-old purpose of preserving the food. Antioxidants prevent it from becoming rancid and humectants keep it from drying out. There are flavour enhancers, bleaching agents and colours, mineral and vitamin supplements, sweeteners and thickeners. And, of course, there are some "foods" which are little more than collections of additives.

In Australia, food additives are controlled by the states and territories under regulations derived from the Food Standards Code of the National Health and Medical Research Council (NH&MRC). The NH&MRC doesn't allow any additives to be used to disguise inferior food and it doesn't allow additives which will reduce the nutritive value of the food or whose safety isn't recognised.

Australian rules have always been more stringent than those used in Britain and the US. For them, all additives are permitted except those that are expressly forbidden; over here, the only additives that aren't forbidden are those that are expressly permitted in the regulations.

These rules allow for a list of more than 270 approved additives. Each has a number and these are the numbers that now have to appear on food labels.The numbering system took a long time to be established here as food manufacturers were concerned that chemical names would put people off. More recently, market research in Europe has revealed that customers have started to think about the numbers as warnings, and many have stopped buying products with numbers on the labels.

Avoiding contaminants is far less easy, though in some respects pesticides and fungicides are like additives: they are there because of products the public has come to expect. If you want your apple to be red, shiny and hard, you may have to put up with preservatives. Similarly, if you recoil at the sight of a maggot, you are probably going to have to put up with the idea that it has been treated with pesticides.

But the problem of pesticides goes beyond fruit and vegetables, as the Australian meat industry discovered to its cost. In May 1987, US quarantine officials found unacceptably high levels of DDT in three shipments of Australian beef. Not long after, the Japanese looked at their Australian beef and discovered traces of dieldrin.

This was a nasty surprise for the industry. DDT and dieldrin both belong to the class of pesticide known as the organochlorides; in high concentrations they are believed to cause cancer and they certainly weren't being fed to Australian cattle. The trouble is that organochlorines, which were widely used in the 1960s and 1970s, can remain stable in the soil for many years, so cattle grazing on land treated with them can develop traces of the chemicals in their fatty tissues.

What the Americans and the Japanese were concerned about were the health risks: in 1987 the US National Academy of Science claimed that evidence suggested that contamination from pesticides and fungicides caused as many as 20,000 cases of cancer every year.

Pesticides and chemical fertilisers don't always justify the cost, either. They can have unexpected effects like methyl parathion, which can stunt the growth of the crops on which it is used; or nitrogenous fertilisers, which can leave wheat susceptible to weavil attack. And they can kill creatures that can be helpful, like earthworms or insects that prey on pests.

Once pesticides have been used they can take a long time to go away. A few years ago Adam Smith, research officer with the Australian Federation of Consumer Organisations, was quoted as saying that there is no living creature in the world that doesn't contain some traces of DDT. Organochlorine residues are likely to remain in our soil for years to come, even though their use for agricultural purposes has been discontinued. Moreover, pesticides are systemic, which

means that they migrate into the food itself and are not soluble in water.

So however much you wash your fruit and vegetables, you won't wash off whatever pesticide residues they may contain (though it is still useful to wash them, because you may wash off contaminated particles of dirt and soil).

But it's important to get things into perspective: everything natural is not necesssarily healthy. The body doesn't distinguish between chemical substances that have been added to food and chemical substances that occur naturally in the food. Dangerous chemicals are dangerous wherever they come from.

Last year Robert Scheuplin of the US Food and Drug Administration told a meeting of the American Association for the Advancement of Science that we are more at risk of getting cancer from traditional "pure" foods than from chemical contaminants. The evidence suggests that for American citizens, only about 7-8 per cent of the risk of getting cancer is caused by the food they eat: about 98 per cent of that risk comes from traditional foods.

It isn't easy to estimate the health risks presented by the chemicals that are added to our food. Because they each represent a very minor part of our diet it is difficult to isolate the effects of any one of them. You can feed the chemical to mice, of course, but how do we know that large doses given to mice over a short period of time are going to have the same effect as small doses given to humans over a long period of time?

It would be a mistake to think of farmers as reckless and indiscriminate users of chemicals. Farmers are consumers too. They eat their own produce, or produce like it, and if there is any danger to be faced they are in the front line.

There is nothing like doing without chemicals to remind you why chemicals were adopted in the first place. Most food retailers are accustomed to produce turned out in the large quantities and of the consistent standard that chemicals have helped to ensure. They are less at home with the variable shapes and sizes of organic produce.

Coles New World has been testing organic produce in twelve of its Victorian supermarkets and, according to a spokesman for the company, has had disappointing results. Not only has the supply been variable but the cost to the consumer has been at least 10 per cent higher than that of conventional produce. Many people just aren't willing to pay more for cleaner produce, even though the experiment was concentrated in supermarkets in the more affluent parts of the state.

But if the demand for organic produce on the Australian mass market is uncertain, there appears to be much more optimism in other countries. The Swedish government is sponsoring a project that aims at a 50 per cent reduction in the use of pesticides by the year 2000.

Late last year, back in Australia, the Department of Primary Industry's Organic Produce Advisory Committee produced its draft of Ausotralian standards for organic produce. If accepted, these standards will enable growers or retailers to label their produce as "organic" or "biological"or "ecological". These labels will indicate that the product or its ingredients were all produced without the use of synthetic chemicals or pesticides and without irradiation.

They will lead to the use of soil whose fertility has been maintained or increased by such methods as green manures, composts, crop rotation and livestock management. The principles will have to have been in use on the land in question for at least three years before the harvesting of products which will be eligible for the labels.Once we have established a national standard for our produce it will be possible for us to enter the wider world of organic marketing.

ALAN SAUNDERS

Excuse me, waiter, there's no food in my food

In the future it will be possible to gorge yourself on ice-cream, yet starve to death. This is the conceivable outcome of the creation of "pseudo-foods"

If "dieting is more bizarre than cannibalism", as Naomi Wolf claims in her recent book *The Beauty Myth*, then what food technologists are busy coming up with must be equally aberrant.

The development of pseudo-foods assumes that the main culinary preoccupation in the developed world is with kilojoule intake, not taste or nutrition. This is based on the hypothesis that we are destined to eat for pleasure only, and since we are going to overeat the best thing we can do is limit the energy value in our foods. The absurd conclusion of this is that eventually we may have foods that look just like foods, taste just like foods, are terrific to eat – but provide no nutritional value whatsoever.

In the future it will be possible to eat a whole meal made up of these psuedo-foods: breads baked from flour substitutes, confectionery stretched with vegetable gums, boosted with artificial flavours and sweetened with sugar substitutes. We will have ice-cream that has no fat or sugar, and therefore no kilojoules because the fat and sugar will have been replaced by analogues.

> "Manufacturers have merely recognised the trend that eating for pleasure is replacing the role of eating as essential for survival."

You could ultimately get a hamburger and chips where the meat is replaced by an industrially-cultured protein, the bun is made from a flour substitute, the butter replaced by a fat substitute and the chips fried in a synthetic oil which the body can't digest – and therefore the kilojoules aren't absorbed. This is food not as a fuel, but as mere indulgence.

CSIRO scientist Dr Robert McBride claims that the techno-fix had its beginnings more than a decade ago with the discovery of the first non-nutritive sweetener. His thesis – which food manufacturers are exploiting – is that the consumer is loyal to sweetness rather than sugar. It's the "mouth feel" and creamy texture of butter or ice-cream, not the cream or butter itself, that appeals.

The first significant pseudo-foods on the market were sugar analogues. The best known are saccharin and cyclamates. One of the most widespread is aspartame, currently found in more than a thousand foods and beverages, mainly overseas. It is 200 times as sweet as sugar and one tablet – the equivalent of a teaspoon of sugar – contains a mere 1.5 kJ. Sold under the brand name NutraSweet, it is a combination of the methyl ester of the amino acid phenylalanine with L-aspartic acid.

Granted approval in the US in 1981, aspartame is used in Diet Coke and Diet Pepsi, Diet Sunkist, dessert mixes, fruit based yoghurts, chewing gum and table top sweeteners. Because it can't be heated aspartame is not suitable for use in foods that need to be cooked. But it can be added to confectionery in the cool-down stage.

Other sugar analogues unclude acesulfame, marketed in the US under the brand name Sunette, and thaumatin, which is only permitted in European chewing gums.

Tate and Lyle, the British sugar giant, recently expressed disappointment that its sweetener Sucralose was excluded from a list of approved sweeteners. Sucralose is made from sucrose by chlorinating three of its hydroxyl groups. It is 600 times sweeter than sugar, it is not digested and the kilojoules aren't absorbed. In that respect it is

similar to a left-handed sugar developed in the US, Lev-O-Cal, which looks and tastes like granulated sugar and can be heated. To produce Lev-O-Cal, a pair of oxygen and hydrogen atoms are moved around (as the name implies) from the right to the left hand side of the sugar molecule. It fools the digestive system into not recognising it is sugar, and again not absorbing the kilojoules.

Even more dietary chicanery, tricking our bodies, is going on in the area of fat analogues, whose aim is to give the "mouth feel" and the flavour of fat – without the kilojoules. Two US companies are developing sucrose polyester as a fat substitute. One, called Olestra, from Procter & Gamble, is made by linking several fatty acid molecules to a molecule of sucrose (table sugar). Because sucrose polyester is not found in nature,our bodies lack the digestive enzymes necessary to deal with it, so it passes through the body undigested. The Japanese Mitsubishi-Kaisei Food Corp is also working on sucrose polyester as an oil substitute.

Frito-Lay in Texas is working on a fatty alcohol ester, DDM (dialkyl dihexadecymalonate) as a fat substitute. This is also minimally digested and is being developed for blending with soy oil for use in frying both potato and corn chips, thereby reducing the fat by 60 per cent.

Then there is Simplesse, launched last year in the US, which is made by heating proteins – whey and eggwhite – to about 82 degrees Celsius for a short period. The protein coagulates, forming tiny beads so small that 50 billion of them will fit into a teaspoon. In water, these tiny particles of protein form a syrup which mimics the smooth texture of fat and creates a rich creamy sensation on the tongue. It is claimed to have only 15 per cent of the kilojoules of fat. Using it in ice-cream more than halves the kilojoules compared with those in normal ice-cream, and in salad dressing reduces them by a factor of four.

Carbohydrate-based fat replacements already in use include gums (or hydrocolloids) that act as thickening agents. Pfizer Chemicals are marketing a polydextrose as a partial substitute for fat in frozen dairy products, nutritional bars, cake mixes and confectionery.

Meat is also in the firing line. In Britain a new meat substitute called Quorn is being promoted as the first new food man has discovered for centuries. Consisting of strands of a tiny fungus, a myco-protein, fed in tanks on glucose, it has the texture of cooked chicken breast. It has half the kilojoules of steamed white chicken meat or boiled egg, nearly a third of those of stewing steak and five times fewer kilojoules than cheddar cheese, but with roughly the same protein as a boiled egg.

The bio-technologists are at it too. There are many companies working on genetically engineering plants. One company in the US has genetically manipulated the coffee plant to produce coffee that is naturally low in caffeine, and another to produce a de-caffeinated bean. Yet another company has inserted into plants a gene that can help reduce the saturated fat in vegetable oils.

A year ago in Britain the first genetically engineered – rather than merely genetically manipulated – organism was released into the food chain. It's a yeast designed to make bread dough rise faster. It was approved for human consumption by the Ministry of Agriculture without any prior public debate. Here in Australia seven genetically engineered organisms have received approval for release into the environment.

One of the more futuristic applications of genetic engineering is to extend the work that has already been done on meat substitutes. You could have, for instance, a meat look-alike into whose structure a gene would be inserted so that the meat actually has a flavour. Thus you might "grow" lamb with a mint sauce flavour or beef with a horseradish flavour.

Also theoretically possible are potatoes, genetically engineered to contain more amylose, a form of fibre that isn't digested. These potatoes, then fried in an indigestible synthetic oil, could produce that food alchemist's dream – the diet crisp.

While these "kilojoule-defying" foods are a technological panacea, there are several dangers. The first is that instead of restructuring eating habits, people will gorge on these guilt-free treats. The second is that the long-term health effects of these man-made foodstuffs have yet to be quantified.

Despite these potential dangers, the reality is that analogues have been developed by hard-headed corporations to meet a consumer demand. These manufacturers have merely recognised the trend that eating for pleasure is replacing the role of eating as essential for survival – depending, I suppose, on your definiton of "pleasure".

CHERRY RIPE

Australia's driving force? Greed

Australia's future depends on our ability to be fully aware of our position on the globe, the forces that drive our economy and how to harness them, and the need for continuing research and development – says SIR MARK OLIPHANT

Australia has been an antipodean outpost of Europe for 200 years. By 2010 it will be rapidly becoming part of Southeast Asia in both population and outlook, economically tied to its neighbours rather than to Europe and America.

SIR MARK OLIPHANT

Selfishness and greed, which arose when agriculture brought settled existence about 10,000 years ago, cannot be eliminated in 20 years, and will continue to provide the driving force in Australia's domestic economy and its economic relations with other countries.

It is my hope, however, that the decline in fertility of the fragile Australian soils, due to overgrazing and overcropping, the destruction of protective trees and shrubs and the overuse of fertilisers will have been reversed by 2010 and that a gradual rehabilitation of the countryside will be in progress. Reforestation on an immense scale may be aiding this process.

The upgrading of the land can only occur if the pressures upon it are reduced dramatically. It will at last be recognised that Australia is a very poor, arid land agriculturally, and that the population which it can support, at a reasonable standard of living, is not much greater than at present. Immigration must become almost zero. Drastic reduction in irrigation will be essential if our rivers are to carry clean water, rather than salts and sewage.

Awareness of the effect on the Earth's atmosphere of burning fossil fuels is growing, and it is possible in 20 years that a significant part of the energy needs of the world – especially of sunlit Australia – will be met by the rapid development of a solar-hydrogen economy, where hydrogen gas, a clean and efficient fuel, is produced from water by solar-generated electricity and distributed by pipelines.

The futility of military defence of Australia – as of most nations – may have been recognised. Guided weapons, which are rockets of very long range fitted with nuclear or conventional warheads and guidance systems of incredible accuracy and freedom from interference, may have made war unthinkable. There is, and can be, no defence against such weapons.

The elimination of expenditure on defence will remove poverty and starvation, as the enormous resources in equipment, materials, energy and manpower now devoted to weapons manufacture become available for peaceful purposes.

The pattern of employment will have changed greatly. Technological changes will eliminate drudgery and the length of people's working life will increase. New techniques will demand greatly increased knowledge and skills, so education will become prolonged and re-education routine. There will be little or no demand for unskilled labour, and what there is will be the province of those who cannot learn to do more difficult tasks. This will create social change that will increase demand for higher quality in writing, theatre, music and for adventures of the mind.

There will be a lessening in the tendency to concentrate retail trade in fewer and fewer mega-centres, which require vast parking areas and elaborate packaging of all items that must increase costs. There may be a recognition that small is indeed beautiful, and the corner shop may reappear, to which people can walk, instead of driving kilometres to buy a kilogram of potatoes.

The export of minerals and wool provides the greater part of Australia's outward trade. There will probably be much more local processing of these materials, so that steel is exported rather than iron ore, and wool is sold ready for spinning and weaving rather than straight from the sheep's body.

The appearance of the resistant viral disease AIDS has alerted medical and health authorities to the need for more research. Viral diseases, however, are far more difficult to eradicate because of the speed with which most viruses can evolve. The common cold and influenza still pose threats to health, despite decades of intensive research, and myxomatosis is losing the fight against rabbits.

'Selfishness and greed cannot be eliminated in 20 years and will continue to provide the driving force for Australia's economy.'

REGINA NEWEY

Much work is going on in Australian medical research centres to understand and manipulate immune responses and so protect people from invasion by viruses. A major discovery is possible that will control such viral diseases as influenza and AIDS. But such work – like all other long-term research that could bring new knowledge and new technologies – is being starved for funds, and too few skilled researchers are being trained.

Australians may have learned, 20 years from now, that the search for new knowledge is even more important than finding new ways of using existing knowledge, and that fundamental research is as relevant to both life and riches as is new technology.

MALZIEU/BADER

Jorg Eichberg (above) has, with Phil Bermann, succeeded in protecting chimpanzees from infection with the AIDS virus.

At last – an AIDS vaccine?

BY MARK WOLFF

A new optimism is creeping across the once-dark landscape known as AIDS. For the first time since the disease was diagnosed a decade ago, researchers believe that the development of a vaccine to resist infection by the human immuno-deficiency virus (HIV), which causes AIDS, is finally about to happen.

Confidence that a safe and effective vaccine can be developed against HIV has permeated the international scientific community, displacing the seemingly-permanent pessimism which resulted from scores of experimental failures with trial vaccines during the 1980s.

New understanding of the virus gathered over the past year has led scientists to believe, finally, that they might win the battle against a viral enemy which has baffled the best minds in medical research. The sense of optimism is reflected in the comment of Professor Jonas Salk, the father of the modern polio vaccine, pronounced at the international AIDS society annual conference in 1990 that vaccine designers "will not be outwitted for long" by the virus.

According to Professor John Dwyer, head of the University of NSW School of Medicine, and chairman of the Asian and Pacific Association for the Prevention of AIDS, recent discoveries about how the virus works and success in vaccination of monkeys have been an enormous boost to the prospects for a vaccine. But, he says, it will take 3–10 years to find the most effective vaccine, thoroughly test its safety, and begin inoculation programmes. Care for the vast number of people who contract AIDS will need to continue for a long time after a vaccine is widely available.

HIV is the first known lentivirus (slow-acting virus) to infect the human race. It took three years for HIV to be identified as the viral cause of AIDS. It has taken a further seven years of concentrated research to unravel the complex structure and behaviour of the virus to the point where promising candidate vaccines are now being tested.

MALZIEU/BADER

A flask of Jonas Salk's anti-AIDS serum made by Hillcrest Biologicals.

Recent clinical trials have succeeded in protecting macaques and rhesus monkeys against a virus closely related to HIV, the simian immunodeficiency virus (SIV). More importantly, two chimpanzees – which along with gibbon apes are the only animals that can be infected with HIV – have been immunised against HIV-1, and have fought off a challenge with a live virus.

HIV is a formidable foe. At each turn scientists studying the virus have encountered some new facet of what appeared to be the disease's demonic intelligence. AIDS vaccine development has been hampered by HIV's ability to escape the body's defences against disease and establish persistent infection.

"Until recently it seemed that the virus had developed tactics so formidable that it had completely outwitted the human immune system."

MAIZIEU/BADER

Jonas Salk, inventor of the polio vaccine.

MAIZIEU/BADER

Bob Gallo, discoverer with Luc Montagnier, of the virus that causes AIDS.

The virus disrupts and then destroys the human immune system by targeting its command and control functions. This is a wicked campaign tactic. The only cells capable of initiating the fight against HIV – the immune system's alarm cells, T4 lymphocytes – are enslaved by the virus to reproduce more viral particles.

Four hundred billion of these T4 "invasion detectors" patrol the body, sending out the alarm to T8 and other immune-system attack cells which destroy the foreign incursion. On average, all of these T4 alarm cells are destroyed in HIV victims after 9.2 years.

In 1984, the US Secretary of Health, Margaret Heckler, announced to the world's press that there would be an AIDS vaccine by the end of that year. Then in 1985 Marc Girard, director of the prestigious Pasteur Research Institute, predicted a vaccine would be developed within six months. Both predictions were made in the light of the discovery and isolation of the AIDS virus. Armed with the sophisticated tools of molecular biology and genetic engineering, the design of a vaccine seemed imminent. But both forecasts proved to be premature.

The AIDS virus deploys three strategies to mislead the body's defences, thus establishing persistent infection:

1. Latency, or the "Trojan horse" strategy, in which the virus enters and hides inside immune cells, only to multiply perhaps years later when the body's defences are diminished.

2. Variability, or the disguise strategy, which results from the virus's ability to mutate rapidly. A person with HIV infection is fighting much more than millions of copies of one virus: within each victim there develop hundreds of varieties of HIV, each recognised by the immune system as a different challenge. The body has to contend with a myriad number of strains of HIV.

3. Low immunogenicity, or the "sugar coated killer" camouflage strategy. The vital portions of the virus which enable it to invade immune cells are folded in such a convoluted way, and coated with so much sugar, that they are barely recognised as foreign particles by the immune system, which is much better at responding to the mostly protein coatings of other viruses.

Until recently it seemed that the virus had developed tactics so formidable that it had completely outwitted the human immune system. If the virus was too clever for the immune system, pessimists reasoned, there would be little hope for a vaccine. Successful vaccination against a viral disease involves prompting of the body's defences by exposure to harmless sections of the virus or inactivated whole virus. This would teach the immune system to recognise HIV, pre-programming a massive immune attack on the live invader if it ever entered the body.

SIPA PRESS

Computer image of the internal structure of the AIDS virus.

The challenge facing virologists has been to find an area of the virus's outer coat that remains structurally constant in all HIV mutations. If there were an infinite number of varieties or strains of the virus, there would be no hope for a vaccine. Hopes for the creation of a vaccine have been dashed before.

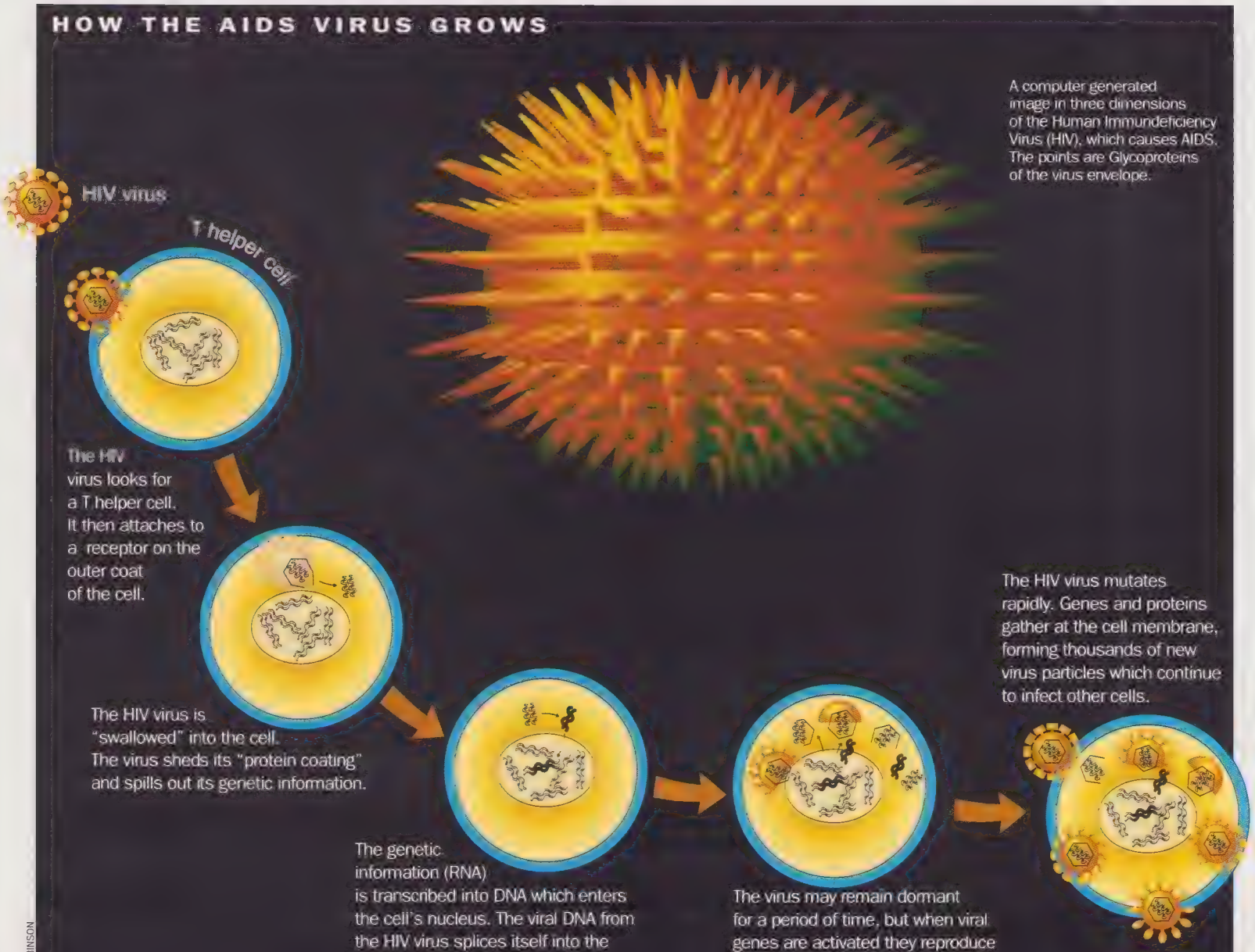
It should have been a simple process. After all, the historic successes of vaccines against viral diseases are legendary. Vaccines have triumphed over smallpox and polio, and the decline of yellow fever, measles, mumps and rubella are also mainly due to vaccination and improved public health measures.

But the research community had yet to encounter HIV's wicked intelligence. The search for a vaccine is a battle of wits, and one of grave urgency. Nature is conducting massive and global biological warfare on the human race. The scale of possible death and misery that could result if humankind loses this battle is staggering. Over 6 million people have been infected with the AIDS-causing virus, according to World Health Organisation statistics. Another 100 million people are expected to contract the virus by the turn of the century, based on estimates by Professor John Dwyer. Without a vaccine or other strategies to prevent the natural spread of the disease, the 21st century would see an AIDS explosion – especially in underdeveloped nations – that could rival the "Black Death" bubonic plague that swept across Europe and Asia over several decades in the mid-14th century.

The turning point in scientific confidence of the prospects for an AIDS vaccine occurred at the International AIDS Society annual conference in San Francisco last year.

Two important factors lead to this confidence. Eighteen months ago, scientists were still uncertain whether the immune system produced a significant enough response to the virus to guarantee that a vaccine could be created. But it appears that people who are still healthy after 5–6 years of infection are producing an immune response which recognises and kills HIV and HIV-infected cells and is responsible for their good health. Their immune system is keeping up with the virus till that stage, but with time this effectiveness is lost.

The body's defences are eventually beaten



because the virus mutates to present to the immune system a wide variety of protein-sugar structures on its surface. The body responds by killing all but the most difficult-to-recognise sugar-camouflaged viral strains. The body's depleted immune system is increasingly faced by an ever more invisible foe.

This accords well with clinical observations that HIV strains in full-blown AIDS patients are much more lethal to the newly infected than strains from carriers whose viral strains are still early in their evolution.

The second critical advance that will assist the fight against HIV is the discovery of a surface structure on the virus which although relatively constant across mutations (some six variations cover 85 per cent of the mutations) changes to escape from the effects of antibodies. This area is known as the V3 loop and is part of the viral "key" which allows it to enter into T4 immune cells by insertion of the key into a cell surface "lock" on T cells known as CD4.

The building blocks of the V3 loop consist of 35 amino acids. The variations are not infinite, and so a vaccine containing the major variations is feasible.

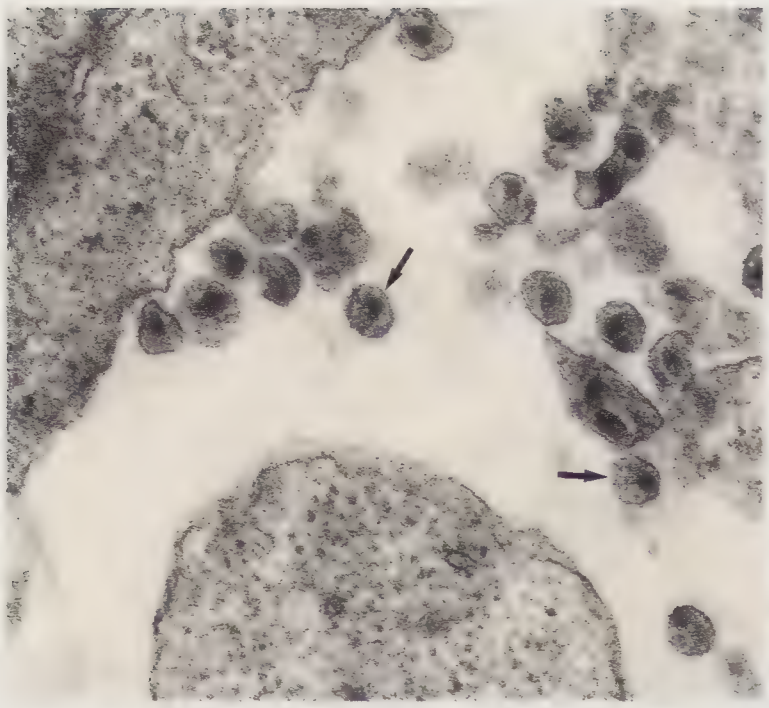
Concentrated effort is now under way to design vaccines that incorporate the V3 loop variations and other structures of end-stage viral mutants.

Two potential uses of a vaccine are now envisaged – a prophylactic vaccine to protect against primary infection with HIV, including the protection of infants born to infected mothers, and the possible immuno-therapeutic use of a vaccine to stimulate an infected person's immune system, as a complement or alternative to therapeutic drugs.

VACCINES TO PROTECT AGAINST INFECTION

AIDS-like diseases in the rhesus monkey are only prototypes of human AIDS. However, it is a useful model since it produces disease within one year. Experiments conducted independently by three groups – Ronald Desrosiers at the New England Primate Centre in Southborough, Massachusetts; Micky Murphy-Corb of the Delta Regional Primate Centre in New Orleans, and Murray Gardner at the University of California at Davis, have shown that two out of six, eight out of nine, and three out of three immunised monkeys, respectively, have shown evidence of solid immunity to challenge with natural virus. The remainder showed evidence of a delay in disease progression. All of these groups used inactivated, whole Simian Immunodeficiency Virus (SIV), which is closely related to HIV.

Chimpanzees are susceptible to HIV (rather than SIV), although they do not get AIDS, possibly because they have more effective killer cells for this virus than humans. Jorg Eichberg, of the South-West Foundation for Biomedical Research, San Antonio, Texas, together



DR J.MARSHALL, FAIRFIELD HOSPITAL

Electron micrograph showing mature HIV (arrowed)..

MALZIEU/BADER

Dr. Jean-Claude Gluckman would never have allowed himself to be injected with an inactive AIDS virus vaccine because the risk of the virus being reactivated is too great.

"Without a vaccine or other strategies to prevent the natural spread of the disease, the 21st century would see an AIDS explosion."

with Phil Bermann of Genentech Inc., San Francisco, have finally succeeded in protecting chimpanzees from infection using a recombinant sub-unit of the HIV coat, gp 120, which includes the V3 loop.

In human trials, Wayne Koff of the US National Institute of Health and Larry Carey of the University of Washington, have reported on a series of clinical feasibility trials using recombinant gp160, another structure of the viral coat, expressed in vaccinia virus (the same virus used for smallpox vaccination). Immune responses have been elicited with the aid of booster injections, and the vaccines tested so far appear safe.

"IMMUNOTHERAPEUTIC" VACCINES

The idea of using a vaccine as a form of therapy, developed by Jonas Salk, depends on the presence of a reasonably intact immune system (early in the disease) and utilises an inactivated virus preparation, stripped of its envelope, and emulsified in an immune "booster" known for many years as Freund's Incomplete Adjuvant.

Early trials in chimpanzees appear safe and promising. Alexandra Levins of the University of Southern California has trialled this approach in 80 volunteers suffering from various degrees of HIV infection short of full-blown AIDS. She has shown the preparation to be safe and, in one particular index of favourable immune responsiveness, to have increased by 60 per cent or more across all subjects.

The next step in this "more is better" approach, using whole killed virus vaccines, is a placebo controlled trial.

More than 50 prototype anti-AIDS vaccines have been registered internationally in a co-ordinated international effort that could halt the AIDS pandemic. HIV is the first ever "slow-acting" virus, or lentivirus, to jump the "species barrier" to humans.

The University of Sydney is undertaking a major study of transmission of HIV among multi-partner heterosexuals. People wishing to support or participate in this project should contact Dr Brian Mulhall on (02) 692 4390.

It may have made this jump to humans from green monkeys, in the jungles of central Africa, 20–80 years ago. Nor is it the only viral disease to have emerged from human encroachment into previously isolated areas – dengue fever, Rift Valley fever, Argentine and Bolivian haemorrhagic fever and Marbung disease are just some of an array of exotic diseases to have emerged in recent years.

As a result, scientists have been forced to re-evaluate how new viral diseases arise. Because of the wide variety of viruses – and the speed with which they mutate – it is tempting to think that emerging viruses are newly evolved. But most "new" viruses are actually a result of what US virologist, Stephen Morse, calls "viral traffic" – the transfer to humans of diseases harboured by animals.

Viral traffic is directed by human activity. Environmental changes caused by war, migration, deforestation and population growth have created ideal conditions for the transfer of viruses from secluded animal reservoirs to the larger human community.

New viral diseases do not represent a radical new trend in viral evolution, but result from an increase in human-animal contact, especially in tropical rain forests, nature's primary bank of genetic diversity.

It is as if we have entered "the heart of darkness", and nature threatens to exact a terrible revenge. But by understanding the molecular behaviour of the AIDS-causing virus – and changing our own sexual behaviour – humanity can be spared what could have been a more serious pandemic.

The "sudden" emergence of AIDS has shown that new viral diseases remain a potent threat to human health. To avoid new viral pandemics, virology must go beyond its current focus on the molecular behaviour of viruses. More needs to be known about host-virus interactions, and environmental impact surveys in tropical are as need to include study of the microbial and viral fauna of regions marked for development.

Emerging viruses can be identified and contained locally before their spread becomes critical. The human cost of failing to do so, as AIDS has shown, is too great.

CONDOMAN SAYS:

DON'T BE SHAME BE GAME

C

PROTECT YOURSELF!

Post-Everythingness &

What goes around, comes around. There's no new thing under the sun (except the constitution of the ozone layer). Young Persons are wearing FLARES, tie-dye T-shirts & peace signs. The New World Order is looking suspiciously like an exercise in nostalgic double standards. Plus ça change, plus ça la même chose, which is French for "yes, as a matter of fact we ARE (still) bombing the crap out of the Pacific & what is it to you?" T.V repeats, political corruption allegations, Jimi Hendrix fans, fundamentalists who teach toddlers' creationism, NSW prison policy: everything old is new again. So - how different can the future be? Oh, the scientists might get to us in the end, with their battery-operated potato peelers, and laser thought-surgery, and weed-powered troop carriers. But inevitably, somebody will make a startling discovery that's as old as the igneous extrusions with snow on the top of them. Want to be innovative, ahead of the crowd? Think of a subject, put the word "post" in front of it, and you're away...

In 2018, Squizzoil Copyright III rediscovers the afternoon nap

At a small barbeque in Sector 8, Washington Dubbo takes some Stupidity, the new designer dreng, and reinvents simple social embarassment (2015).

the Patently Obvious

The fFox-Terrier family rediscovers the sing-along in 2027, after their entertaino-mat suffers atmospheric disorder.

Faced with a 3 year delay on parts for the Gravitro-Willywagon Mark 2 in 2003, Gloria Manicurist rediscovers how to fix the fan belt with an old stocking.

Temporarily unable to attend the Computer De-skilling centre during Operation Feral Population in the late 2020s, Helena Consultant stumbles into the Object Museum, hallucinates and rediscovers art.

Their Orgasmo-Implants Broadcast interrupted by asteroid showers, Floyd Garbo and Maisie Allegation reinvent sex in 2043. Soon it becomes a fad to rival hula hoops.

After several quirils of Nuvo-Fantta for courage, and realising that Boris had not left the Pubcapsule for 3 years and never so much lifted a fingerlet around the Reside Unit, Beryl Underling rediscovered feminism in 2045.

In 2013, Slobodan Mbuto developed an allergy to Wasteburgers, discarded his Approxo-Girl and reinvented home-made jam. He celebrated with a Devonshire Tea in the Botanical Gardens.

-Kaz Cooke

London International Group

SETTING NEW STANDARDS IN THE FIGHT AGAINST AIDS

There are now very few countries which remain unaffected by the AIDS pandemic. Within this context, there has been a resurgence of interest in the condom, which is recognised as having an important part to play in safer sex practices.

London International Group is the world's leading manufacturer of branded condoms with well-known trade marks such as Durex, London, Hatu, Personal, Contatto, Ramses and Sheik. The pre-eminent position places on us the responsibility to ensure that our condoms meet the highest standards of quality and reliability, vitally important for the prevention of unwanted pregnancy and sexual disease transmission.

The group is wholly committed to raising international standards to protect consumers worldwide by improving the quality of products available and to working continuously to improve attitudes towards condoms. We share our expertise and knowledge and so have become a major world source of information and research on barrier contraception, sexually transmitted disease and public health education.

Condoms are produced on glass formers which are dipped into latex, dried and dipped again

SAFER SEX AND THE CONDOM

The recognition of the condom's role in AIDS prevention has brought about a general reappraisal of its benefits, both as a prophylactic and as a contraceptive. Condoms are recognised as a safe, effective and reversible form of contraception.

A British Department of Health comparison of various contraception methods showed the efficacy of the condom to be similar to that of the progestogen-only oral contraceptive. This low failure rate is further improved when recommendations for proper use are brought to the attention of inexperienced couples.

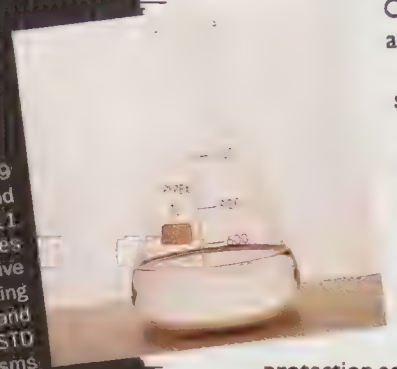
Most doctors agree that only condoms made to stringent quality standards offer protection against a wide range of sexually transmitted diseases, some of which are implicated in HIV transmission. A reduction in the incidence of some STDs will reduce the probability of transmission of the Human Immunodeficiency Virus (HIV). Laboratory studies have shown that the intact latex condom is a complete barrier to viruses such as HIV and herpes simplex II virus, responsible for genital herpes, and even the minute hepatitis B surface antigen.

A study which followed up the uninfected spouses of AIDS sufferers who continued with sexual intercourse, demonstrated that condom use can provide highly significant protection against the disease's transmission.

National standards for condoms are based on use during vaginal intercourse. The stresses on condoms during anal intercourse have not been fully assessed, but as there are indications that breakage rates are much higher, standard condoms are not recommended for anal use.

There is a significant body of evidence that wide usage of condoms should substantially reduce the spread of AIDS and other sexually transmitted diseases (STDs). Modern condoms made by London International Group and other reputable manufacturers are thin and strong, with a typical wall thickness of 0.04 to 0.06 mm. Thin though this is, the unbroken latex film is a complete barrier to bacteria and viruses. Laboratory studies have demonstrated that, under vigorous conditions designed to mimic coitus, condoms do not allow the passage of viruses, even when the viral pool used is at a considerably higher concentration than would be found in infected individuals. There are also studies to show that condom use in high risk populations reduces the risk of HIV acquisition. Studies on stable homosexual and heterosexual couples where one partner is infected show that condoms have a highly significant protective effect.

Accurate investigations of the barrier properties of elastomers, including latex, is now possible with an in-vitro method developed by London International Group, in which harmless sub-microscopic particles are substituted for HIV or other viruses. Research has demonstrated that Nonoxynol-9, the active ingredient of many spermicidal lubricants used with condoms, is effective in inactivating HIV and the other STD organisms. Studies on spermicides made by London International have shown



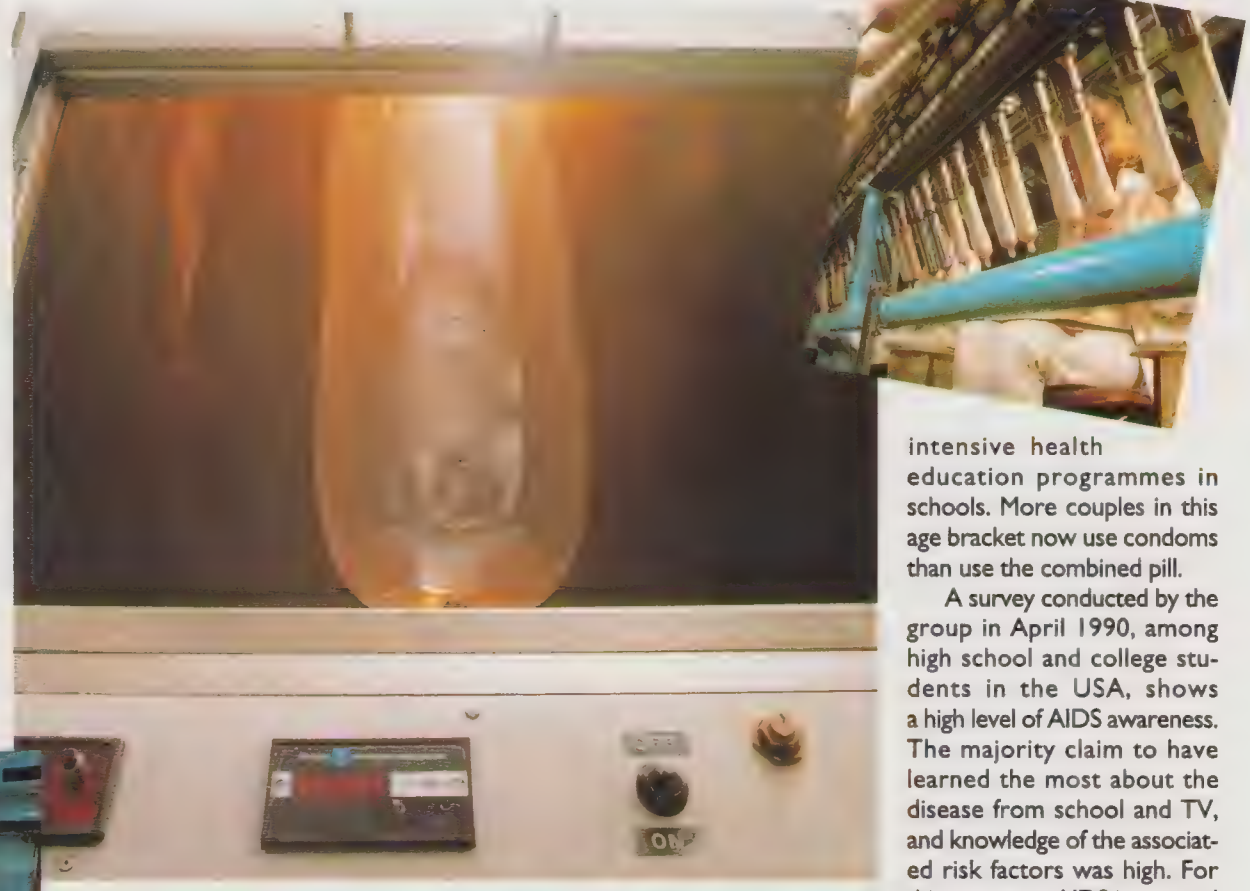
Nonoxynol-9 and Nonoxynol 11 Spermicides are effective in inactivating HIV and other STD organisms

that normal doses of these products are highly effective in rapidly inactivating HIV. Nonoxynol-11, also widely used as a contraceptive agent, has similar properties.

London International Group is the leading manufacturer of high quality branded condoms in the world, with 4 major manufacturing sites in the UK, USA, Italy and Spain, and a joint venture in India. It is also co-operating in a manufacturing project with Russia to build condom factories.

The company employs approximately 575 people worldwide in the manufacture of condoms. More than 40 percent of the group's manufacturing staff are employed in quality control and nearly 100 tests are carried out from sourcing of raw materials to final packaging.

In addition to meeting all relevant national standards, each condom is individually electronically tested to discover any flaws, as an additional safety measure. The Air Inflation Test, which is not required by all countries' standards, is carried out routinely on sampled batches of condoms in London International manufacturing sites. This is a test of elasticity, strength and integrity, which in-volves a condom being filled with air until it bursts. London International condoms typically hold approximately 40 litres of air, equivalent in volume to nine gallons of water, before bursting. This is almost three times the minimum allowed in the newly published International Standards Organisation (ISO) standard. This type of test is the only one which tests the strength of the entire condom, and it has been carried out on London International condoms routinely for over 10 years.



ABOVE: Air inflation tests are carried out on sampled batches. London International condoms typically exceed the minimum of the ISO standard by three times.
TOP RIGHT: Every condom is electronically tested. Any current leakage results in the condom being automatically rejected.
LEFT: Quality control samples are removed from each batch, filled with 300mls of water and suspended for at least one minute, and examined for fluid leakage.

In addition to London International's stringent quality control procedures, external inspectors from standards bodies test samples from our factories, from wholesalers' stock and from retailers. Inspectors visit our factories unannounced to satisfy themselves that the various testing procedures are being implemented, and that records of testing are accurate. The company is committed to a policy of global sourcing, which enables it to meet demand while at the same time retaining local flexibility, by ensuring that all its factories produce condoms to meet or exceed all worldwide standards.

BEHAVIOUR CHANGE NEEDED

There is no doubt that radical changes in behaviour, and a significant change in attitudes towards condoms are required for the spread of the disease to be halted. This is true for all "at risk" groups. Only the resources at the disposition of Governments can achieve this change, as the investment required is beyond the scale of the condom industry. Research commissioned by London International in the UK indicates that while awareness of the dangers of AIDS can be generated by significant promotional activity, this awareness tends to decrease when the issue is not heavily promoted. Behavioural changes are slower to engender, and many heterosexuals are complacent about the potential for contracting the disease. This study demonstrated that the most receptive group are the 16-20 year olds – possibly benefiting from intensive health education programmes in schools. More couples in this age bracket now use condoms than use the combined pill.

A survey conducted by the group in April 1990, among high school and college students in the USA, shows a high level of AIDS awareness. The majority claim to have learned the most about the disease from school and TV, and knowledge of the associated risk factors was high. For this age group AIDS is a crucial issue, at least as important as deforestation, depletion of the ozone layer, wars and famine. Ninety per cent of respondents knew that using condoms was a precaution against AIDS and 69 percent recognised remaining faithful to one similarly responsible partner as another.

There is clearly a significant gap between knowledge and behaviour, as although three-quarters of the sample were sexually active, only one third claimed to use condoms regularly. However, if teenagers have responded to the threat of AIDS, according to the study the 20-30 age group are less receptive. This is disturbing, as they tend to be the most sexually active group. It is also disconcerting that many people who believe that they have changed their behaviour because of AIDS, are not adopting safer sex routines but relying on their judgement of the likely previous sexual history of their partners. The group believes that similar patterns of behaviour exist in most of the developed world, and can be expected in many other countries. Therefore it is imperative that a continual program of education, at all levels of society, is a priority for government and health administrators. Manufacturers, too, have a significant role to play. London International Group companies throughout the world run extensive educational and promotional programs to continue to improve attitudes towards condoms, and thus make them more acceptable. The need for education is paramount. The resistance to be overcome in many parts of the world includes the problems of supply and cost, cultural and religious conviction, social taboos and the belief that condoms impede sexual enjoyment. However, it is only by overcoming these challenges, through cooperation and consistent endeavour, that AIDS will be defeated.

A Titanic on a collision course

Our technological civilization is totally unadapted to the needs of survival says CHARLES BIRCH, Emeritus Professor of Biology at the University of Sydney. Unless we make it adaptable, we too will go the way of the Brontosaurus

One of the scientists who discovered the relationship between chlorofluorocarbons (CFCs) and the depletion of the ozone layer is reported to have gone home one night and told his wife: "The work is going well, but it looks like the end of the world."

There is extraordinary unanimity among ecologists on the catastrophic effects of human activity on the life-support systems of the world. Their work is going well, but their predictions are dire. They see the world as a Titanic on a collision course.

In the words of a cartoon summing up the tangled opinions of non-scientists on population growth, resource depletion, environmental deterioration and world poverty: "Eventually we will run out of food to feed ourselves and air to breathe . . . this is something we must learn to live with."

The Brontosaurus probably said the same as he headed for extinction. His trouble was that he was unadapt-able. Our technological civilization is totally unadapted to the needs of survival. Unless we make it adaptable we too shall go the route of the Brontosaurus.

CHARLES BIRCH

There is something radically wrong with the way we are living on Earth today. The sort of society we are building with the aid of science and technology has self-destructive features built into it. That there are limits to the resources of the Earth, and its capacity to cope with the pollution of its waters and atmosphere, has led to what is known as the 'impossibility theorem'. This states that the high rate of consumption and pollution of rich nations would be impossible for all the peoples of the Earth.

That poses a real problem of justice. Can those who live in the rich world morally justify a way of living which would be impossible for the rest to enjoy? It is now widely agreed that the industrialisation of the whole world in the way the rich world is industrialised would be lethal to the planet. In an ecologically sustainable world, with a more just distribution of wealth, a nation would be over-developed when its citizens consumed resources and polluted at a rate greater than would be possible for all the people of the world.

Since the carrying capacity of the Earth would be exceeded should everyone in the world be rich, then a small proportion of the people can be rich and a large proportion will remain poor — as at present. Alternatively, the rich could reduce their rate of consumption and pollution in order that the poor may increase theirs. The rich must live more simply so that the poor may simply live.

Yet economic systems the world over, including ours, operate as though the problems of injustice and poverty will be solved by letting everyone, rich and poor, grow in wealth together as fast as they can.

The ecological message is clear. Our basic task is to reduce as rapidly as possible the impact of humanity on the Earth's life-support systems.

That impact is the product of three components: the number of people, per capita consumption of resources (affluence), and the environmental damage done by technologies used to support that affluence. It follows that to reduce human impact on the environment we must reduce population size, reduce consumption away from selfish greed to meet basic human needs, and change technologies such as eliminating the manufacture of ozone-depleting CFCs.

There is much misunderstanding about all three components of the human impact. For example, the population problem is not primarily one of the poor world, but of the rich world. It is not the crude numbers of population density that should concern us. It is the impact of people on the life-support systems and resources of the planet.

The impact per person of the rich world is something like sixty times that of a person in the poor world. It is the rich world that is creating a lethal situation for the entire world. It is the rich who dump most of the carbon dioxide and CFCs into the atmosphere. It is the rich who generate acid rain. And the rich are "strip-mining" the seas of fish and pushing the world towards a major fisheries collapse. The agricultural technology of the rich is destroying soils and draining supplies of underground water around the globe. And it is the rich, such as ourselves, who are wood-chipping forests to make cardboard to wrap around Japanese electronic products.

Not only is the basis of human life being destroyed by our activities, but we are annihilating each year at least a thousand species who share the planet with us. This is nothing less than a holocaust of nature.

Total spiritual confusion prevails in the modern world about the relationship of humanity to nature in a technological culture. Churches and theologians, intimidated by secular culture, leave that task to others. Our way of life is tied to an anthropocentric ethic that sees the non-human world as simply the stage on which the drama of human life is performed. All other creatures have no more than instrumental value to us.

What is now urgently called for is a biocentric ethic that sees in all life some intrinsic value as well as instrumental value. Sentience, the capacity for feeling, gives life intrinsic value. This is true not only of us but of other living creatures. A great achievement of the Enlightenment was to build a theory of human rights which made possible enormous advances towards social justice. A great achievement of our time could be to extend the concepts of compassion, rights and justice to all living creatures, not only in theory, but in the practice of a biocentric ethic.

Yet the advocacy of western religious thought is weakest precisely here, where the ache of the world is strongest. The whole of creation cries out in agony for its liberation. Can religions remain silent on this agony any longer?

Australians desperately need to discover a national vision of the future. Is all that matters increased GNP, reduced inflation and reduced overseas debt? Instead of measuring national health in terms of economic growth, we could set our eyes on a more worthy goal: a healthy (whole) people in a healthy environment with healthy relations to that environment, which includes the non-human creatures who share the Earth with us.

Are we willing to pay the price of the redemption of that part of the Earth we inhabit in terms of a revolution in values, in lifestyles, in economic and political goals, and even in the nature of the science and technology we practise? The stage is set. Whether the play can be performed before the theatre burns down remains to be seen.

It's the most remote place on earth and little is known about it, yet Antarctica is crucial to the future of the rest of the world. With a human population ranging from 1,000 to 4,000, Antarctica has no local sources of pollution. Unlike other continents, changes that will take place in the Antarctic will be caused by activities conducted elsewhere on earth

BLEAK BEAUTY

BY DR PATRICK QUILTY

THE GREENHOUSE EFFECT

ABOUT one sixth of the earth's surface is covered by the Antarctic. But the scientific effort expended there is minuscule compared with that of any other equivalent area on earth. As a result, early predictions of the effect of climate change due to increased levels of greenhouse gasses in the atmosphere were not soundly based.

On the basis of historical records and modelling, it is now believed that the amplitude of global change is greater in polar regions than in the temperate and tropical zones – so any greenhouse induced temperature change will be greater in the Arctic and the Antarctic.

Initially it was feared that Antarctic ice would melt and lead to relatively fast rises in sea level, as much as five metres by the year 2050. New estimates show that sea level change may be only one millimetre a year, about what it is now. The sea level may even fall due to increased precipitation. Any rise in sea level will be primarily due to the expansion of sea water caused by the increase in temperature.

Scientific attention has been focused on the West Antarctic ice sheet which is smaller, warmer and generally thinner than its East Antarctic counterpart, and is in many places underlain by sea water.

Scientists are studying the area of contact of the ice sheet with the underlying rock and the effects of increased melting rates under the adjacent ice shelves. Such changes could lead to increased flow rates for the glaciers from the ice sheet – but the effects may be considerably less than predicted only a few years ago.

It is possible that in 100 years, increased accumulation of ice on West Antarctica alone may be responsible for a sea level fall of about 10 cm; but in 200-300 years, a rise of about 30-40 cm is expected.

Above: Icebergs floating north are the first sign that the traveller is nearing Antarctica.
Left: The "Icebird" at the ice edge, Mawson/Davis Stations.

Page 83: Tabular iceberg near Davis Station.

Page 84: Winston Glacier and lagoon, Heard Island.

Page 86:
Above:Krill *Euphasia Superba* at the Antarctic Division laboratories.
Below: Tabular iceberg, breaking up and soon to roll.

STRATOSPHERIC OZONE DEPLETION

OZONE is critically important for life on earth because it absorbs harmful wavelengths of ultra-violet light. Without this absorption, life would be very different.

In the mid-1980s scientists from the British Antarctic Survey discovered that, in springtime, the concentration of ozone in the Antarctic atmosphere falls by up to 65 per cent. The depletion is sudden and the level of ozone recovers over a six-week period. This depletion has been directly linked to the use of chlorofluorocarbons as a propellant or in refrigeration.

While the depletion began as an Antarctic phenomenon, the mixing of the ozone depleted Antarctic stratosphere with that of the rest of the world has led to a global ozone depletion of 2-3 per cent.

The potential effects of this on all life forms are now being researched, particularly on those organisms that live in the upper few metres of the seas around Antarctica. The phytoplankton (minute floating plants) are the "grass of the sea" and the source of food for the higher levels of the tree of life in the region. Harmful changes at this level of the food chain will undoubtedly have an impact further up the chain.

Over the next decade, the secrets of Antarctica must be probed. The future of life on this planet may depend on an understanding of the forces that shape our environment – and hence that of the future. Antarctica may hold some of the keys to unlock this knowledge.

The part Antarctica plays in storing much of the earth's fresh water, and the depletion of stratospheric ozone, are two of many issues still to be investigated. We Australians mostly live by the coast and expose ourselves to the sun on a regular basis. This lifestyle is already threatened.

Future pressures on this isolated continent, such as mining, tourism and fishing, will serve to raise the level of awareness of Antarctica, but a strong commitment to increased scientific research is necessary. Australia has a clear responsibility to pursue every avenue possible. Our future may depend on it.

CORPORATE VISIONS

Gas & Fuel

CORPORATION OF VICTORIA

Improved efficiency has ecological and environmental advantages as it reduces both energy demand and greenhouse gas emissions.

At the Gas and Fuel Corporation we strive to increase the contribution gas makes to the energy needs of the Victorian community. Our aim is to ensure that Victorian business, households and institutions gain maximum benefit from the state's gas resources.

In recent years, both the community and the government have become increasingly concerned with ecological and conservation issues. The Corporation has responded by implementing a range of broad-based initiatives which include pioneering work in appliance energy labelling, the development of high efficiency appliances and the provision of energy consultancy services to industry and commerce.

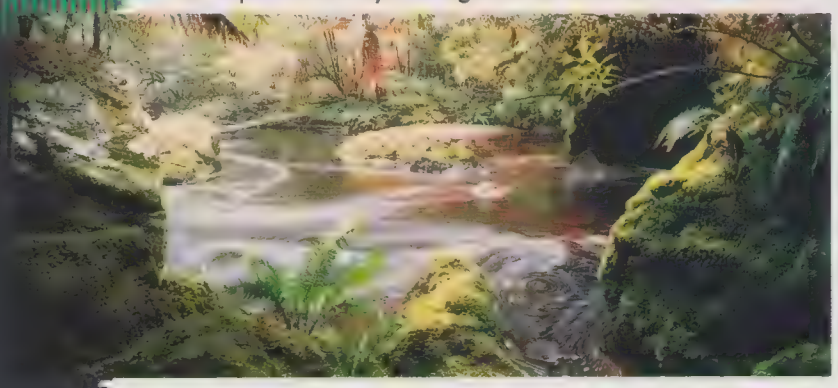
High efficiency and conservation

Improved efficiency has ecological and environmental advantages as it reduces both energy demand and greenhouse gas emissions.

Of all the high grade fossil fuels, natural gas has the highest "well head to user" efficiency. By further increasing appliance efficiency the Gas and Fuel Corporation is able to build on this strength.

Cogeneration

Cogeneration can be used on industrial and commercial sites to produce at least two forms of energy from a single fuel source. Typically, a gas turbine is used to generate electricity while exhaust heat is used to supply process heat requirements. By utilising on-site exhaust heat, which would



otherwise go to waste, cogeneration can realise efficiencies of up to 80 per cent. Excess power can then be sold to the electricity utility. The Gas and Fuel Corporation and the State Electricity Commission of Victoria are working together in this area.

Gas for motive power

Industrial plants which require large amounts of motive power can utilise gas driven reciprocating engines to produce it. In some cases the exhaust and cooling heat can be used for process heat.

Solar/gas appliances

Gas assisted solar hot water services can reduce the amount of gas used by up to 60 per cent. The Corporation is working with manufacturers to develop these hybrid solar services for the local market.

Energy label

Energy labelling provides a means by which to measure consumer requirements against manufactured products. By enabling intending purchasers to compare the energy consumption of seemingly similar appliances, consumers are able to select products which best meet their heating and cooking requirements. In turn, the scheme encourages and rewards manufacturers working to produce high efficiency appliances. Since the programme began in 1982, appliance efficiency has increased by up to 40 per cent.

Ecological and pollution issues

The greatest challenge facing the world today is the struggle to achieve a balance between the essential utilisation of natural resources, and detrimental effect on the environment. Like other fossil fuels, the use of natural gas produces greenhouse gases. The Corporation acknowledges this fact and strives to minimise the environmental impact by keeping the community informed of the most effective and efficient ways of using natural gas.

These goals will be reinforced through demand management studies which shift the focus from supply considerations, to conservation activities.

Future trends and new initiatives

Gas is consistently at the forefront of new technologies and markets because it is adaptable. The Corporations's success is based on the ability to supply customers, old and new, with the fuel, appliances and services they need. Many of the activities mentioned above will form the backbone of more effective processes in the future.

Intelligent house technology

This technology integrates appliances by using a central control system. It allows appliances to interact efficiently with each other and the "building envelope". Householders are able to control appliances by use of a remote unit (the office telephone for instance) to provide an efficient environment where the building, the external and internal environments are carefully co-ordinated to optimise energy consumption.

Alternative transport fuels - NGV

Natural Gas for Vehicles (NGV) utilises natural gas as a fuel. Unlike LPG (a mixture of propane and butane), natural gas (which is almost entirely composed of methane) has a high cetane rating. Cetane is the diesel equivalent of octane, and this means that natural gas can be used in diesel engines.

With decreasing supplies of indigenous crude oil available over the coming decade and the increasing demand for energy, the success of alternative fuel programmes is of national significance. NGV will enable us to use natural gas as an efficient and effective substitute for diesel fuel in bus, truck and other depot-based fleets.

Solar houses

The Corporation is undertaking research to understand how the structure of the house contributes to the living environment. Solar house technology has the potential to significantly reduce home heating and cooling requirements.

The Gas and Fuel Corporation aims to meet the short and long term gas energy needs of the Victorian community. We are certain that a positive approach to the future, along with developing and embracing new technologies, is the key to meeting the shared goals of community and utility.

How Will the Gulf War Affect the Future?

The Gulf War was one of the more significant events of the latter 20th century. But what did it achieve – and what lasting impact will it have on human affairs?

BY PETER KRIEN

It is in the nature of human beings to want something positive to emerge from such destructive events as war. That there is not a great deal of evidence to support such expectations seems not to deter the desire for them. It is, perhaps, the species' survival mechanism at work, the thing that allows mankind to endure great hardships and carry on.

The Gulf War, which ended after 43 days with the defeat of the Iraqi army and the reversal of Saddam Hussein's takeover of Kuwait, is no exception. Despite great expectations, there is little basis in fact for the hope that this war, a war in which right and wrong were clearly defined, should prove to be the sword that cuts through the Gordian knot that is the Middle East.

There are, however, some pointers to the future that can be drawn from this most unusual, swift, brutally technological, environmentally disastrous war. But a warning to readers: most scenes in this prognosis are fairly gloomy.

➢ In future wars, 'smart' weapons will be used – but their success is far from certain. After all, will future adversaries be as inept as Iraq?

It would be tempting to see the US-led coalition's victory over Iraq as an endorsement of the American way of war, a vindication of the enormous sums of money poured into the development of "smart" weapons and surveillance systems, a pointer to how future wars will be fought and won. Tempting but dangerous: military history is littered with the wreckage of armies whose generals fought their wars on the strategic truths of previous victories.

In fact, it has been suggested that the Iraqi military, which failed at every level to live up to either Saddam Hussein's rhetoric or its own fearsome reputation, was trounced so soundly at least in part because it hoped to fight the coalition with the tactics it successfully employed against the even more dated "human wave" strategy of Iran in their eight-year war. Against a foe equipped with space-age technology and weaponry, that strategy was doomed to failure.

The Gulf War reasserted in dramatic fashion what has been accepted as a truth by military planners since at least World War II – air power and superiority in the skies are essential ingredients for the successful prosecution of a war, particularly in terrain as open as this particular theatre of war.

A French laser-guided AS-30 missile, fired from a Jaguar jet, explodes on a bridge in Iraq. Picture taken from French television.

While many elements – including absolute control of the skies, superior training, the ability to move armour and troops quickly, and the luxury of more than six months' lead-time to plan the campaign – combined to produce what can only be described as a rout, the Gulf War is a clear pointer to the ever greater role that high technology will play in future conflicts. Video-equipped "smart" bombs, heat-sensing targetting devices, satellite reconnaissance, surveillance and early-warning systems, night vision technology, anti-missile defence systems, and much more will on every general's wish list in the future.

➢ The environmental damage was horrific. How permanently horrific is too early to tell.

Aside from the human cost, the full consequences of Iraq's resort to "environmental terrorism" in Kuwait and the Persian Gulf will take years to realise, let alone eliminate. Kuwaiti authorities estimate that Iraq damaged more than 80 per cent of Kuwait's wells and almost every one of its petroleum support and transport facilities.

Despite the priority being given to capping up to 600 sabotaged wellheads – most of them ablaze and spewing millions of barrels of oil a day – it will be at least a year before all are brought under control. In the meantime, vast lakes of oil are being created, tonnes of carcinogenic pollutants are pumped into the atmosphere to the probable detriment of the health of the people in the region.

It is estimated that the unprecedented conflagration is consuming anywhere between 3-6 million barrels of oil a day and producing about 500,000 tonnes of soot a month. Some experts predict that reduced sunlight and subsequent reductions in surface temperatures will diminish agricultural production. The smoke, they say, will produce tonnes of damaging acid rain.

The giant oil spill into the Persian Gulf will wreak its own particular havoc on that delicate eco-system for years to come. While nature has a remarkable ability to heal itself, the process is a slow one. In the meantime, marine and bird life will suffer and local fishermen will be deprived of their livelihood.

➢ Environmental terrorism has now been established as a military tactic — but can its potential disaster be outlawed by international treaty?

While scientists disagree on the extent of the environmental damage, they agree that the world must try to ensure that this type of eco-terror can in no way be justified as a legitimate strategy, that steps are taken to protect the environment, the world's commonwealth, in future conflicts.

Existing conventions governing the conduct of war must be strengthened, possibly a new treaty negotiated. This would not, of course, provide an iron-clad guarantee that such action would never

again occur. But in the words of the *Guardian* of London: "Most military authorities do plan their tactics within legal constraints as shown by the almost universal adherence to the Geneva conventions . . . a [new] treaty would be a useful addition to the laws of conflict and might, hopefully, prevent another such environmental disaster triggered as a deliberate act of war."

➢ Oil prices will probably remain stable in the short-term. But the war has not offered enough incentive for the west to push more strongly to find alternative energy sources.

There is no question that a major reason for America's prompt response to the invasion of Kuwait and the possible danger to Saudi Arabia was the threat to a major source of a strategic resource – oil.

Experts predict the likely outcome of the war is an extended period of low to moderate prices. Even with Iraq and Kuwait temporarily out of the marketplace, the world is awash with oil and many analysts do not expect it to rise above $US20 a barrel for several years.

Saudi Arabia believes a moderate price is in its long-term interest – it benefits its customers and discourages development of other, high-cost, alternative sources of energy. With the protection of the US, the Saudis do not have to fear such OPEC militants as Iran and Iraq when they boost production to keep prices down.

The war, then, will not have accelerated the cause of conservation or the search for alternative sources of energy.

➢ The economic fall-out: the oil-rich states are strengthened, the west enjoys a mild short-term benefit.

On the economic front, the Arab world may try to come to grips with an issue that Saddam Hussein exploited to great advantage, even in the streets of Arab countries officially ranged against him: the disparity between the haves (the oil-rich Gulf states) and the have-nots such as Egypt, Algeria and Jordan.

Significantly, however, at the first post-war Arab League meeting in Cairo, Egyptian Foreign Minister Esmat Abdel-Meguid, dismissed the view that the rich Arab nations must share their wealth. Future inter-Arab relations, he said, must be based on the notion that "each Arab country has total sovereignty on its natural and economic resources."

If anything, the Gulf War has probably strengthened the position of the oil-rich Gulf states. For although it has increased their dependence on the US, who saved them from Iraq's ulterior ambitions, the war formalised western/US support to defend its middle east oil supplies — and thus, presumably, the countries which own that oil. Whether that support extends to the current regimes in those countries is another matter.

For the rest of the world, the harm of the war disappeared with the fall of the price of oil. The US and much of the world was either in recession or heading that way before the war began and the oil price hikes sparked by the invasion of Kuwait only served to speed up that process. An obvious outcome of the successful prosecution of the war is a restoration of confidence, however mild. According to American economist Laurence Meyer: "The political gains [from the war] are likely to be so large that we're going to consider this one of the best investments we ever made."

➢ Security in the region: don't hold your breath for a major diplomatic breakthrough.

While the threat of a militant Iraq has been sharply diminished, there is little cause for optimism that a workable and universally acceptable Middle East peace will result from Operation Desert Storm. In the short term, some kind of UN-sanctioned peace-keeping force will remain in southern Iraq and Kuwait and probably Saudi Arabia.

Yet, there is little evidence to suggest that the holy grail of a larger Middle East peace plan is any closer. Even the US, its credit rating undeniably bolstered in the region, is looking for incremental progress rather than major breakthroughs. Secretary of State James Baker is pinning his hopes on a two-track process in which Arab states make concessions to Israel while it moves towards a dialogue with the Palestinians.

Arab commentator and author, Fouad Ajami, writing in *US News and World Report,* put it this way: "No-one can predict with any assurance what a new political order in the Arab world might look like. But this is an old and stubborn world. It won't reinvent itself. The old status quo was given a reprieve. Don't look for the Arab world to make great, new changes. After the storm, men seek their beds, relieved that an old order is given a new lease of life . . . In war, matters were simple and straightforward. We now go into a twilight, somewhere between war and peace, deep into a region that remains difficult for us to fathom, let alone reorder to our likes . . . But the work of making a civilisation see its way out of its own thicket, of making it shed its own deadly dreams and delusions, is a matter beyond any foreign saviour's reach and power."

"Don't look for the Arab world to make great, new changes. After the storm, men seek their beds, relieved that an old order is given a new lease of life."

Arab commentator and author Fouad Ajami

"The political gains [from the war] are likely to be so large that we're going to consider this one of the best investments we ever made."

American economist Laurence Meyer

Meanwhile, the Kurds – an ancient Indo-European, largely Sunni Muslim people with their own language, culture and traditions, and living in an arc stretching from Iran to Iraq and Turkey with smaller communities in Syria and the Soviet Union – are perhaps the worst victims of the war, and are likely to remain in the international community's "too hard" basket.

➢ Iraq will struggle financially, militarily and politically.

Not only does Iraq face the gargantuan task of reconstructing itself, but the US and its UN allies insist it must pay reparations for the enormous damage done to Kuwait. Given that the country's foreign debt is some $US100 billion, that its infrastructure has been shattered, that it is rent by internal divisions, it is difficult to see how Baghdad will pay to repair itself, let alone meet other obligations.

Militarily, there is no reason to doubt the assessment of General Norman Schwarzkopf that Iraq will not be a regional threat for years to come. Under the stiff terms of the permanent UN cease-fire, the eventual loss of its weapons of mass destruction should eliminate it as a major regional power.

➢ Kuwait's reconstruction will create boom times for US and allied companies.

The wholesale destruction and looting of Kuwait's infrastructure and the brutal treatment of its population ensure that it will be some years before the emirate emerges from its national trauma. Estimates of the cost of rebuilding Kuwait range as high as $US200 billion over the next decade.

Western companies, particularly those whose nations sent military forces to liberate Kuwait, will be the main beneficiaries of lucrative reconstruction contracts.

But the social fires ignited by the crisis may prove thorniest for the country's leadership. There is considerable pressure for social and political reform and to bring traditionally disadvantaged groups into the mainstream.

Monash University

BY MAL LOGAN

Australia in the 21st century will need to depend on its cleverness. That means its educated workforce, its ideas, and the exploitation of those ideas. Universities, therefore, are the axle of the wheel of fortune of Australia's future – for universities educate the clever people of the nation, create the knowledge from which the ideas develop, and increasingly are a partner in the exploitation of the ideas.

Monash University has positioned itself to be a major contributor to the development of a clever Australia in the 21st century. The positioning has included mergers and restructuring, targeting research areas of excellence and potential, engendering a co-operative spirit with industry and commerce, adopting new approaches to teaching, revamping its courses, orienting itself towards the Asia Pacific rim, and focusing on the clients of the University.

MERGERS AND RE-STRUCTURING

The merger of the former Chisholm Institute of Technology and the Gippsland Institute of Advanced Education with Monash University added new strengths and diversity and provided an opportunity for a re-structuring that created a University much more prepared for the future. New faculties were developed – including Faculties of Computing and Information Technology, Professional Studies, and Business. Other faculties were reorganised to reflect contemporary needs. An important addition was a Distance Education Centre, located at Gippsland but serving the total University. And the teaching techniques of distance education, which have always been at the forefront of technological innovation in teaching, will permeate on-campus teaching as well.

As a four-campus institution (Caulfield, Clayton, Frankston and Churchill in Gippsland), with over 30,000 students, Monash provides University education of the highest quality to one of the few population growth corridors in Victoria – the outer south-east of Melbourne, Gippsland, and Westernport. Those students have already voted with their feet, with substantial increases in demand for courses on all campuses in 1991.

CO-OPERATION WITH INDUSTRY AND COMMERCE

Joint research and opportunities for the sharing of expertise with business are fundamental to the contribution of universities to Australia's future. Part of the Monash strategy is the Monash Technology Precinct which consists of a major cluster of research centres, together with more than 700 industrial and service companies within 850 hectares in the region around Monash University's Clayton campus. Its development has been endorsed by the two local councils.

Since the precinct was formed the degree of co-operation with the University has increased dramatically. By the year 2000 the Monash Technology Precinct will be a centre of ideas development and exchange making major contributions to Victoria's and Australia's economies.

Further examples of Monash strategies in science and technology include externally funded Professorships in Communication and Information Engineering (Telecom funded), Electrical and Power Engineering (SECV funded) and Meteorology (Bureau of Meteorology funded). Joint ventures include the Centre for Geographical Information Systems (with Nixdorf Computers) and the Australian Pulp and Paper Institute. Other Monash centres taking a strong entrepreneurial approach include the Centre for BioProcess Technology and the Centre for Molecular Biology and Medicine. Montech Pty Ltd, the Monash University technology and consulting company, has placed over $2 million worth of business and government contracts with Monash. Fields concentrated upon include advanced materials technology, industrial pharmacology, biotechnology, telecommunications policy, and scientific instrumentation.

In applying research to community issues, Monash targets the pressing public concerns of health, safety, efficient public sector management, and public and professional ethics. Projects addressing these issues include: the Accident Research Centre; the National Centre for Health Program Evaluation; the in-vitro fertilisation programme; the Public Sector Management Institute; the Centre for Human Bioethics; and the National Key Centre for Australian Studies. The University has strong links with the Playbox Theatre Company and with the Australian Centre of Contemporary Art.

The Monash-ANZ Centre for International Briefing is a leading example of interface between the University and the business sphere. The ANZ Bank has contributed $1 million to the centre which intensively briefs companies, government agencies and individuals on how best to conduct business with Asia.

Further exciting possibilities are offered by the addition to Monash of the David Syme Faculty of Business. The faculty has a strong profile in the commercial world, exemplified by the fully externally funded Australian Centre for Retail Studies; the Centre for the Development of Entrepreneurs; and the David Syme International Business Centre.

ORIENTATION TOWARDS THE PACIFIC RIM

A re-orientation towards Asia is an essential element of Australia's economic future. Yet our cultural links, including our intellectual development, have been traditionally focused on the west and western ideas development.

Monash has moved beyond the first phase of an Asian orientation – teaching and research in Asian Studies and Asian languages (Monash is nationally recognised as Australia's leading university in these fields). The goal of the second phase is to mainstream Asian Studies. The University is forging collaborative agreements with a number of targeted universities in countries throughout the Asia Pacific region. The collaborative activities include joint research projects, staff visits in both directions, student exchanges, and summer schools for Monash students in sister universities in Asia.

Youth must seize the initiative

Young people are in a unique position to do something to help save the global ecology says SUSANNAH BEGG. If they don't they will be the first generation to suffer the consequences

Each generation inherits a set of circumstances from its forebears. My generation is inheriting a planet that has an uncertain future. Those who are currently in positions of power are too frequently making decisions that protect the status quo, but cast a shadow on the long-term survival of this planet.

Young people are in a unique position to do something to help save the global ecology. The decisions being made now will impact on our future. Young people today are well informed and are willing to contribute to finding and implementing the strategies needed to protect the natural environment.

SUSANNAH BEGG

I therefore implore the governments of the world, environmental and developmental organisations and all other decision makers, to consider the input of young people in the development of programmes that could ensure an equitable and environmentally secure future for us all.

We have a clarity of vision, uncluttered by political expediency, that can see through the economic pragmatism that seems to plague the environmental debate. Young people hope that International Union for the Conservation of Nature (IUCN) has this vision. We are imbued with a sense of urgency. We hope that this general awareness will be able to raise its sights to a mission which declares a need to conserve nature for nature's sake and not merely for its sustainable use.

At the moment we have a planet in crisis. Species are continuing to disappear from the face of the earth at a frightening rate. Wilderness areas are being marginalised as urban and population pressures claim greater space. Failure to fully test technologies and products such as CFCs have contributed to the depletion of the ozone layer. Tropical forests are being torn down in many instances to enable developing countries to meet payments on their foreign debt. There is a widening gap between the affluence of the developed world and the poverty of the developing nations.

If the current generation fails to prevent global warming, it will be my generation and those who follow who will suffer the consequences. We have a right to demand a safe future. Those making decisions now have a responsibility to provide a future that is environmentally sustainable.

In June last year, as part of the Australian Conservation Foundation Youth delegation, I was privileged to be able to attend the London meeting of the Montreal protocol on substances that deplete the ozone layer.

I found this conference a saddening and disillusioning process. I was amazed that a conference intended to save the ozone layer could sanction a 30 per cent increase in the chlorine loading of the stratosphere. I was also shocked by the cynicism of the diplomatic world. For too long people have blindly placed their future at the mercy of diplomatic processes I witnessed in London.

But the Montreal protocol was enormously heartening. This was the first international environmental negotiation attended by a youth delegation. This is something I strongly believe should be a mandatory input to all similar meetings.

Our energy and sense of urgency can be an inspiration to those in power for faster and more progressive reform. We have a vision that in all future decisions that impact on the environment, young people, from all over the world, will be involved to ensure that these decisions reflect inter-generational equity and an active concern for the environment.

I envisage young people forming an international environmental network that channels information and co-ordinates environmental actions. Young people could work worldwide on global projects with time-lines geared towards negotiations on environmental treaties.

You, the delegates attending this IUCN General Assembly, can help young people achieve this goal. By freely sharing information and including us as part of your processes, we can help IUCN convince governments and industries of the need for a change in attitudes towards the natural world.

Young people around the world are faced with uncertainty and fear. We have a fundamental right to live in a world that can support life. Yet this right is threatened by continual ecological compromises. But we also face the future with hope.

On behalf of my generation and all generations to come, I call on the people of the world to act to ensure no further compromises are made which will put our environment in jeopardy. We have only one earth. We may only have one chance at saving it. Let us not blow this chance, and our future away.

This is the text of a speech to the IUCN in late 1990.

DID YOU KNOW?

- A Drongo is actually a glossy black bird found in the warmer parts of Australia.
- There is no difference between a Thick–knee and a Stone–curlew.
- The Weebill is Australia's smallest bird, weighing only six grams.
- Millions of wading birds migrate to Australia each year from Siberia.
- The Royal Australasian Ornithologists Union (RAOU) is Australia's oldest national conservation organisation.

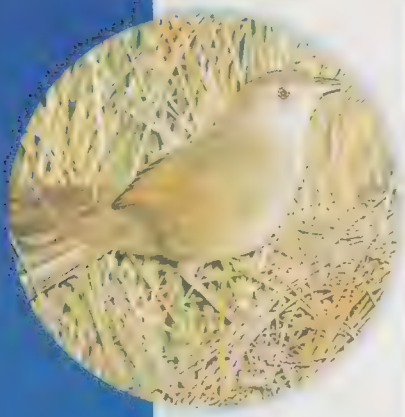
Founded in 1901, its members are dedicated to the conservation and study of native birds.

Our members can be found all over Australia. Why not join one of our many conservation projects, or simply take part in the relaxing hobby of birdwatching? For more information write to:

Royal Australasian Ornithologists Union (RAOU)
21 Gladstone Street, Moonee Ponds, Victoria 3039 Telephone (03) 370 1422
or call in for a Chat, or a Tattler or a Babbler...

GOING,

HISTORY REPEATS ITSELF



GOING,

IF WE ALLOW THESE BIRDS

...GONE

TO DIE OUT

Birds hold a unique place in our society. Most people can name their favourites, hardly anyone dislikes them, and they hold a prominent place in folklore, mythology, religion, science and the arts. But – many species are disappearing.

BY DAVID ANDREW









The plumage, song and behaviour of birds have made bird-watching one of the fastest-growing pastimes in the world, already involving millions of people. People notice birds – they are among the most abundant of all creatures and are the most-studied group of animals on earth.

Australia is a land of birds. From remote cays in the Coral Sea to the high mountains, a huge diversity of species is found, often in staggering numbers. Over 750 species have been recorded and three hundred of them are found nowhere else in the world – they are endemic. Yet since European settlement seven species have become extinct and another 52 (eight per cent of our total) are threatened with extinction unless we take action to save them.

Birds are also valuable bio-indicators. The presence or absence of birds in a forest or swamp can give us an indication of the health of the environment.

To birdwatchers, naturalists and scientists this is old news. The Royal Australasian Ornithologists Union (RAOU), Australia's oldest national conservation organisation, has been studying bird populations for 90 years. Since then, at least one species, the Paradise Parrot *Psephotus pulcherrimus*, has gone the way of the Dodo, and another, the Night Parrot *Geopsittacus occidentalis*, has been seen only a few times. In the same period many other species, such as the Orange-bellied Parrot *Neophema chrysogaster*, Hooded Plover *Charadrius rubricolis* and Regent Honeyeater *Xanthomyza phrygia* have declined alarmingly.

The major threats to Australia's birds are habitat destruction, altered patterns of burning due to increased population and clearing for agriculture, and introduced animals. Other factors such as hunting and the pet trade have had a major effect.

Habitat destruction is the single biggest threat to native birds. This includes clearing of native vegetation for agriculture, mining, development or settlement, and change to vegetation and landforms such as those caused by stock and rabbits.

Early settlers can hardly be blamed for clearing vast areas of land. Unfamiliar with the Australian bush, their lives were often a struggle against a hostile environment. But the effects of their efforts, such as erosion and increased salinity, are now apparent.

The clearing of old-growth forests has directly affected cockatoos, hawks and owls by decreasing the number of nesting hollows. Prey species, such as possums and gliders, are also affected by clearing. Fragmentation of forests has isolated populations. There is no better example of this than the Black-eared Miner *Manorina melanotis*, Australia's rarest bird and down to 11 birds. Much of its habitat, old growth mallee in south-eastern Australia, has been cleared, forcing it into less suitable habitat where it interbreeds with the aggressive Yellow-throated Miner *Manorina flaviventer*.

Broadly speaking, there are two categories of feral animals: those that prey directly on birds and those that cause disturbance or damage to their habitats. The first category includes cats, foxes and rats, and the second, rabbits and a host of hoofed animals such as stock, buffalo, donkeys, pigs and goats.

The speed with which exotic animals have become established in our environment and spread to even the most remote corners of the continent, has meant doom for many native birds. Feral cats are deadly killers that can reproduce rapidly and after a few generations in the wild revert to the familiar tabby colouration, giving them excellent camouflage.

The introduction of rats to islands has taken a terrible toll of native birds: the Robust White-eye *Zosterops strenua* was wiped out when rats came ashore to Lord Howe Island after a shipwreck. The Norfolk Island Ground-Dove *Gallicolumba norfolciensis*, and Lord Howe Island Starling *Aplonis fuscu* also succumbed to introduced predators. A recent survey found that in one study site 90-100 per cent of young Malleefowl *Leipoa ocellata* were killed by foxes.

The Southern Cassowary *Casuarius casuarius* of tropical Queensland is a large flightless bird that as an adult has no natural predators. However, there is some evidence that feral pigs kill and eat their eggs and young.

Australia's ancient, friable soils evolved in the absence of ungulates, or hoofed animals. Our native grasses have shallow root systems that are rapidly destroyed by trampling and close-cropping. Not surprisingly, the introduction of millions of livestock spelt disaster for our grasslands as they rapidly cut up the soil and caused widespread erosion. The problem was compounded when many were released or escaped, spreading and reproducing at an incredible rate. There are now millions of feral ungulates in the outback. Culling scarcely makes a dent in their populations and the damage they have caused is huge.

Hunting is thought to have caused the extinction of two bird species: the King Island and Kangaroo Island Emus *Dromaius minor* and *D. baudinianus*, respectively. It is indeed fortunate that only one other species, the Freckled Duck *Stictonetta naevosa*, appears to be under any threat from hunters.

Egg-collecting is illegal in Australia, but there is some ignorance surrounding the practice: it is a commonly-held belief that the stolen eggs are incubated and the young raised for the pet trade. In fact, collectors empty the eggs of their contents and store them, much as a philatelist would store stamps in an album. Eggs of rare birds command a high price and as a result collectors take every egg in a clutch, often visiting the same nest several seasons in a row. In Australia egg-collectors are regarded as a significant threat to some hawks.

"Birds are valuable in many ways . . . to lose one more species would be a tragedy"

G. MATTHEWS

Norfolk Island Starling, now extinct

Bird smuggling is a problems. Trappers smuggle live birds, particularly parrots and finches, out of Australia and into the collections of aviculturists overseas. This too is illegal, but vast financial rewards and the difficulty of policing our remote northern coastline ensure that it continues. The birds are transported en masse, drugged and stuffed into suitcases, trouser legs or other suitable containers. Many die on the way.

Thanks to the efforts of conservation groups, most people are now aware that our birdlife is under threat. So what can people do to help Australia's birds?

The simplest step is to join a bird conservation organisation. The RAOU employs scientists to monitor threatened species and welcomes the assistance of amateurs to help with surveys of waterfowl, migratory waders and other rare species. This sort of hands-on activity is of direct benefit to conservation: teams of several hundred people are often required to survey an area simultaneously to get an accurate assessment of a bird's population.

The RAOU has recently launched the National Action Plan for Birds. The plan will review the 25 most threatened species and make recommendations for their continued protection.

There is no doubt that our attitude to wildlife has changed. Birds have gone from mere game to valued assets, culturally, aesthetically and financially. The preservation of habitat helps ensure the continuation of species.

We are fortunate that in many states a comprehensive series of national parks exists to preserve suitable habitat. However, many birds are not, and never will be, protected by national parks and some have become economic pests. Much research remains to be done, and not just on rare species. It is equally important to study common birds so that we have adequate warning should something go wrong – either with their populations or ours. The Australian Bird Count, another RAOU project, sponsored by BP Australia, monitors long-term and seasonal changes in populations of bush birds with this end in mind.

Birds are valuable in many ways – attractive, harmless and common creatures that help us to monitor the environment. Australia's birdlife is known the world over. Visitors flock to see lyrebirds, kookaburras and especially our magnificent parrots. To lose one more species would be a tragedy.

Page 92–93: VULNERABLE BIRDS left to right: Eastern Bristlebird N.CHAFFER/NPIAW, Red Goshawk J.M.CUPPER/NPIAW, Mallefowl RAOU, Partridge Pigeon T.& P.GARDNER/NPIAW, ENDANGERED ONES left to right: Golden-shouldered Parrot L.ROBINSON/NPIAW, Regent Honeyeater G.CHAPMAN/NPIAW, Forty-spotted Pardalote D.WATTS/NPIAW, Orange-bellied Parrot D.WATTS/NPIAW AND THE EXTINCT left to right Kangaroo Island Emu G.MATTHEWS, Norfolk Island Ground dove J.HUNTER/EMU, Paradise Parrot J GOULD, Robust White-eye J GOULD.

Vulnerable

Vunerable bird species are those where most or all of the populations are decreasing through over-exploitation, extensive destruction of habitat or other environmental disturbance. These species are likely to become endangered if the factors leading to their vulnerability are not addressed.

CHRISTMAS FRIGATEBIRD

Fregata andrewsi

The Christmas Frigatebird breeds only in rainforest on Christmas Island in the Indian Ocean, which has been intensively mined for phosphate. Disturbance, poaching and habitat destruction associated with municipal and mining development have threatened its survival in the past. Though most of its habitat is now reserved, its status is justified by its small population and earlier decline.

The current population is estimated at 1,000–2,000 pairs.

RED GOSHAWK

Erythrotriorchis radiatus

Still to be found in forested country throughout much of its historical range, the Red Goshawk exists at very low densities. The breeding range, however, is much less than the total range and has contracted. Deforestation and egg-collecting are probably the major threats, while the use of agricultural chemicals may be detrimental to the species in a part of its range.

There are no accurate measures of abundance for the Red Goshawk, but the number of reported sightings suggests it to be at very low densities.

MALLEEFOWL

Leipoa ocellata

In the last century the population of this megapode has declined throughout its range, disappearing entirely from parts of it. Clearance, grazing and frequent burning of the low eucalypt woodland it inhabits have been the main causes as well as heavy predation by foxes. Further contraction of the Malleefowl's range is almost certain.

Originally found over large areas of southern, central and western Australia, the Malleefowl is now restricted to semi-arid rangelands and small habitat remnants in the dryland cropping zone in south-west and central NSW, north-west Victoria and southern South Australia.

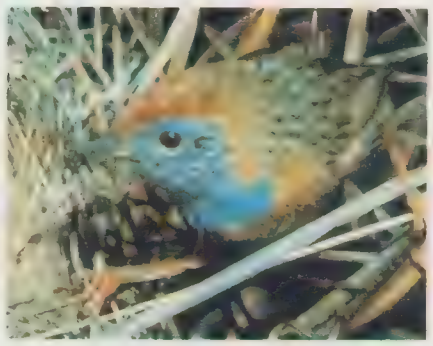
The population in NSW is estimated at 750 breeding pairs and in Victoria at less than 1,000 pairs. There are no population estimates for either South Australia or Western Australia.

PARTRIDGE PIGEON

Petrophassa smithii

This terrestrial woodland pigeon currently occupies only a fifth of its pre-1925 range in the north and north-west of Australia, probably at a much-reduced density. Degradation of small waterholes by exotic animals and altered fire regimes appear to be the main factors responsible for its decline, which may be continuing.

No estimates of the population size of the Partridge Pigeon are available. However, some inferences about the changes in population size in the areas of the Northern Territory where the species persists can be made. The Partridge Pigeon appears to need to drink daily and may walk two kilometres and more to small waterholes. The population is probably most concentrated in the square kilometre round such waterholes and a density of 20 per sq km might be expected in suitable habitat. The small groups of about 12 birds currently seen at waterholes do not compare favourably with the groups of nearly 100 reported earlier.



RAOU

Mallee Emu-wren
Stipiturus mallee

I. PEDLER/NPIAW

Baudin's Black-Cockatoo
Calyptorhynchus baudinii

H GRAY/NPIAW

Christmas Frigatebird
Fregata andrewsi

BAUDIN'S BLACK-COCKATOO

Calyptorhynchus baudinii

This black-cockatoo is still distributed throughout most of its pre-European range in the temperate forest of south-west Australia. However over significant parts of its range it is threatened by loss of nest sites through forestry production practices. The longevity of the species may as yet be masking insufficient recruitment. Distributed in forest areas in the higher rainfall areas of the south-west of Western Australia. Most are found south-west of a line drawn between Perth and Albany.

Baudin's Black-Cockatoo was only distinguished as a separate species in 1979. Previously, the combined population of the two sorts of 'White-tailed Black-Cockatoo', Baudin's and Carnaby's Black-Cockatoos, were estimated to be in the range of 14,000-60,000. Numbers of Baudin's Black-cockatoo probably exceeded 5,000.

MALLEE EMU-WREN

Stipiturus mallee

This emu-wren occurs in low heathlands and mallee shrublands with porcupine grass in north-west Victoria and adjacent parts of South Australia. More than half the habitat within the species' range has been cleared for farming and the fragmented remnant populations appear to be threatened by wildfires. There are no estimates of population size.

EASTERN BRISTLEBIRD

Dasyornis brachypterus

This bird has been reported in recent times only from the heath-rainforest or heath-woodland boundary at about 20 isolated locations between south-east Queensland and eastern Victoria. Some populations are continuing to decline because of altered fire regimes, the effects of exotic plants and animals, and clearance of vegetation. All sites from which it has been reported are within 100 km of the coast.

There are no estimates of the population size of the Eastern Bristlebird. Its population along the Queensland-NSW border has been estimated at about 500 individuals. In Barren Grounds Nature Reserve, Budderoo National Park and Jervis Bay Nature Reserve, the total population is probably 1,000-2,000 individuals.

Endangered

Endangered species are those in danger of extinction and whose survival is unlikely under current conditions. Included are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are species that may now be extinct but have definitely been seen in the wild in the past fifty years.

ABBOTT'S BOOBY

Sula abbotti

This booby now breeds only on Christmas Island in the eastern Indian Ocean. Its population was severely affected when much of the mature rainforest in which it breeds was cleared for phosphate mining. Extrapolations from censuses conducted in 1967 and 1974 put the breeding population then at fewer than 3,000 pairs. Surveys indicate that by 1983 the population had declined to about 2,000 breeding pairs and that the decline is continuing.

GOLDEN-SHOULDERED PARROT

Psephotus chrysopterygius

This parrot is now found in small numbers in a very restricted area of savannah woodland in north-east Queensland. The destruction of habitat, particularly breeding habitat, by grazing and altered fire regimes and heavy trapping during the 1950s and 1960s, are suspected to be the reasons for its decline.

The Golden-shouldered Parrot's present distribution is a strip 120 km wide by 225 km long centred round Musgrave and Koolburra. No attempt has been made to estimate the entire population.

ORANGE-BELLIED PARROT

Neophema chrysogaster

This small parrot was formerly numerous. A small but stable population survives, breeding on the forested margins of coastal sedgeplains in south-west Tasmania. The parrot breeds only in south-west Tasmania and migrates through the islands in the west of Bass Strait and overwinters on mainland Australia, usually within 10 km of the coast. The Orange-bellied Parrot was apparently fairly numerous during the 19th century, when flocks of thousands were reported. Since 1981 its population has fluctuated around 150.

REGENT HONEYEATER

Xanthomyza phrygia

This bird occurs in temperate woodlands and open forest in south-east Australia. It has declined greatly in numbers and disappeared from some parts of its former range. The species is widely dispersed and has declined dramatically for no immediately obvious reason.

Formerly found throughout south-east Australia, reported sightings now centre on a few sites in north-east Victoria and central-east NSW.

Until early this century it congregated from time to time in 'thousands' or 'immense numbers'. Recent surveys suggest that the current total population may be less than 1,000 birds.

RAOU

Black-eared Miner
Manorina melanotis

J.B.NELSON/NPIAW

Abbotts Booby
Sula abbotti

AMERICAN MUSEUM OF NATURAL HISTORY/NPIAW

White-breasted White-eye
Zosterops albogularis

A.D.&M.C TROUNSON/NPIAW

Gouldian Finch
Erythrura gouldiae

BLACK-EARED MINER

Manorina melanotis

This colonial honeyeater is now known to exist in only five locations in mallee woodland in Victoria, and its population is extremely small. Its decline has been caused by widespread habitat clearance which resulted in the spread of the Yellow-throated Miner, a species that prefers more open country, than the Black-eared Miner.

Unless action is taken very soon genetic swamping will cause the extinction of the Black-eared Miner.Three colonies of miners containing up to eight, apparently pure Black-eared Miners were located in 1986; another study in 1989 found 11 at five sites. Hybrid miners were present in all colonies.

FORTY-SPOTTED PARDALOTE

Pardalotus quadragintus

This bird is endemic to open forest of White Gum in Tasmania. It was formerly widespread and locally common in the eastern half of the island but is now restricted to eight populations surviving on islands and coastal peninsulas on the east coast. These populations are threatened by habitat clearance or degradation through altered fire regimes and grazing. These changes appear to have favoured the aggressive honeyeater, the Noisy Miner, whose range is mutually exclusive with the pardalote and may be the primary reason for its decline.
The total population has been estimated at 2,500-3,000 individuals.

WHITE-BREASTED WHITE-EYE

Zosterops albogularis

The white-eye is endemic to Norfolk Island. The last confirmed record is from 1980 but unconfirmed sightings persist. Clearance of forest and competition from the recently-arrived Silvereye have probably brought about its decline.

Regarded by some as "on the verge of extinction", or "extinct", residents on the island consistently report small numbers of birds fitting the species' description.

GOULDIAN FINCH

Erythrura gouldiae

The Gouldian Finch occurs in open grassy woodland in north-central Queensland, northern Northern Territory and the Kimberley of northern Western Australia. It has greatly declined in numbers and range, particularly since the mid 1970s. Historical, anecdotal records indicate that the Gouldian Finch was abundant early this century but has declined dramatically. It is estimated that the two main breeding populations in the Northern Territory, currently the stronghold for the species, contain about 500-800 adult birds each.

Extinct

Species listed as extinct have not been definitely located in the wild in the last 50 years.

KING ISLAND EMU

Dromaius minor

This little-known emu, once common on King Island north-west of Tasmania, was hunted to extinction early in the 19th century.

The King Island Emu was present "in great numbers" at the beginning of the 19th century. The year of its extinction is unknown. Hunting with dogs by seal hunters is thought to have been the principal reason for its disappearance.

KANGAROO ISLAND EMU

Dromaius baudinianus

This emu was formerly found on Kangaroo Island, South Australia, becoming extinct around 1827. In the southern districts of the island the Kangaroo Island Emu was apparently confined to an area between Cape du Couedic and the Pennington Bay District and inland to at least Kelly Hill caves, Mount Taylor and Hawk's Nest. On the north coast it occurred in the Penneshaw District and near Nepean Bay.

It was reported as abundant in 1819, but probably became extinct about 1827.

NORFOLK ISLAND GROUND-DOVE

Gallicolumba norfolciensis

The virtually unknown Norfolk Island Ground-Dove has not been recorded since 1800. Occurring only on Norfolk Island, no estimates of the previous population are available.

Presumably a species of coastal forest, the Norfolk Island ground-dove was probably exterminated by hunting and, if ground-living, by the introduction of rats and cats.

NORFOLK ISLAND KAKA

Nestor productus

This little-known parrot was first recorded by Captain Cook in 1774. In 1851 the last bird died in captivity in London. Confined to Norfolk and Philip Islands, it appears to have been hunted to extinction by convicts and settlers.

No historical information regarding numbers of the Norfolk Island Kaka appears to be available. The scant information available comes from John Gould, who during his stay in Sydney saw a living bird in the possession of a Major Anderson. The species was apparently found among rocks as well as in the tallest trees. The birds were very tame and fed on the blossoms of the white-wood tree or white hibiscus. They laid four white eggs in a hollow or hole in a tree.

The convicts and early settlers are said to have killed kakas, presumably for food.

PARADISE PARROT

Psephotus pulcherrimus

This parrot formerly occurred in woodland in south-east Queensland and north-east NSW. The last confirmed sightings were in 1927. Though rumours of its continued existence persist, it is now presumed to be extinct.

The Paradise Parrot formerly ranged from near Rockhampton, Queensland, south to the Inverell district in north-east NSW. During the years of European exploration and spread of settlement, the 1840s-1880s, these parrots were fairly abundant. By 1900 they had disappeared from most of their range. A few pairs were located in the 1920s, the last confirmed report dating from 1927.

Pairs and family parties of the Paradise Parrot occurred along river valleys in open woodland with a grassy understorey. It fed on native grass seeds and the apparently total disappearance of the species was probably hastened by the reduction in the availability of native grass seeds. This has variously been suggested to have resulted from drought and overgrazing, altered fire frequences, the spread of the prickly pear, or a combination of these factors.

J.GOULD

Norfolk Island Kaka
Nestor productus

G.MATTHEWS

King Island Emu
Dromaius minor

AUSTRALIAN MUSEUM/NPIAW

Paradise Parrot
Psephotus pulcherrimus

ROBUST WHITE-EYE

Zosterops strenua

The robust white-eye was endemic to lowland forest areas of Lord Howe Island in the south-west Pacific Ocean. Formerly numerous it rapidly declined to extinction following the rat invasion that followed the wrecking of the 'Makambo' in 1918 and could not be found in 1928.

NORFOLK ISLAND/ LORD HOWE STARLING

Aplonis fusca

Two subspecies of this starling formerly existed. The subspecies endemic to Norfolk Island has not been recorded since 1923 and that endemic to Lord Howe Island not since 1918. There are no estimates of the previous populations of the Norfolk Island/Lord Howe Island Starling, though during the period 1913-15 it apparently occurred in "thousands" on Lord Howe Island.

The preferred habitat of the Norfolk Island/Lord Howe Island Starling is not known. The Lord Howe Island subspecies disappeared soon after the introduction of rats in 1918 but at Norfolk Island apparently died out more than 20 years before rats arrived.

This article was complied with the generous assistance the Royal Australasian Ornithologists Union (RAOU). The listing of birds has been taken from ***Threatened Birds of Australia - An annotated List*** *edited by J. Brouwer and S. Garnett (RAOU Report Number 68) current as at May 1990. Birds included are those threatened on a worldwide basis. This does not include sub-species of birds that are secure on a worldwide basis but threatened in Australia e.g. Southern Cassowary.*

Transmitting to "Young Optimists"

"...the coolest of the youth stations"

The Age 1990

With the upheaval on Melbourne air-waves over the past few years changing formats, changing ownerships and changing frequencies there has been one constant – Triple-R FM, Australia's most listened to public radio broadcaster. Triple-R continues to play a vibrant and essential role in contemporary lifestyle.

In the late seventies, in the early days of Melbourne's public broadcasting, Triple-R, issued with an 'E' (Educational) class licence began its fledgling efforts from a cramped terrace house in the inner suburbs. Soon it was to prove itself a vital force on the air-waves with its unique blend of education and alternative music – education in the broadest cultural sense, music that set trends.

Those early years have become legend with their heady blend of adventurous programming, live-to-airs, concerts and crucial involvement in the local cultural scene. The good news for the next decade is that the popularity and influence of Triple-R continues unabated. Programming is as varied and adventurous as ever and the audience continues to expand into the 100's of thousands.

Triple-R is the most listened to public radio station in Australia with an audience of 323,000.

Roy Morgan Research – 1987

Best radio station in Melbourne.

Rolling Stone Magazine Readers Poll 1990

Public Radio enjoys a special relationship with its audience because it receives their direct financial support. Triple-R has a base of over 8,000 subscribers who now contribute more than $200,000 in the course of each year.

During the last decade tertiary institute funding has largely given way to funding from this audience support and sponsorship from the entertainment industry.

With an annual budget of only $600,000 – Triple-R is truly the 'low cost, high interest' radio station.

To meet the technology challenges of the next decade, 1991 will see new standards of transmission equipment at the Nunawading transmitter site.

This development project for the nineties will require a significant injection of additional funds, and Triple-R will look beyond its traditional support base. The corporate community will be invited to assist in this project with the very real benefit of being able to reach the unique audience of public radio, a very large audience seldom reached by the commercial media.

Its inner city and tertiary origins may have led to a somewhat stereotyped image of the typical Triple-R listener but the actuality is a different story. The cafe-hopping, carefree student carousing at a pub while enjoying the many alternative bands still exists but has been joined by a far more diversified audience than the Triple-R founders ever imagined.

In January – June 1990 a Roy Morgan Consumer Research Survey found that over 80% of Triple-R listeners are under the age of 35, that 54% have been or are now engaged in some form of tertiary education, and that they are culturally active and 'socially aware'.

The Triple-R audience is characterised as 'young optimists' seeking to improve their prospects in life and the 'look at me' group seeking an exciting life, an eye to fashion and trends.

The lifeline to the Triple-R audience is kept flowing by the combined talents of 10 full-time staff and over 90 volunteer announcers creating more than 70 different radio programs to cater for a diversity of tastes. The volunteers may be teachers, stockbrokers, lawyers, students and musicians who all share an abiding passion for radio – whether it be working on talks programs or presenting music shows.

Current affairs, environment and specialist music programs emanating from Triple-R are networked weekly across more than 20 other public radio stations throughout Australia.

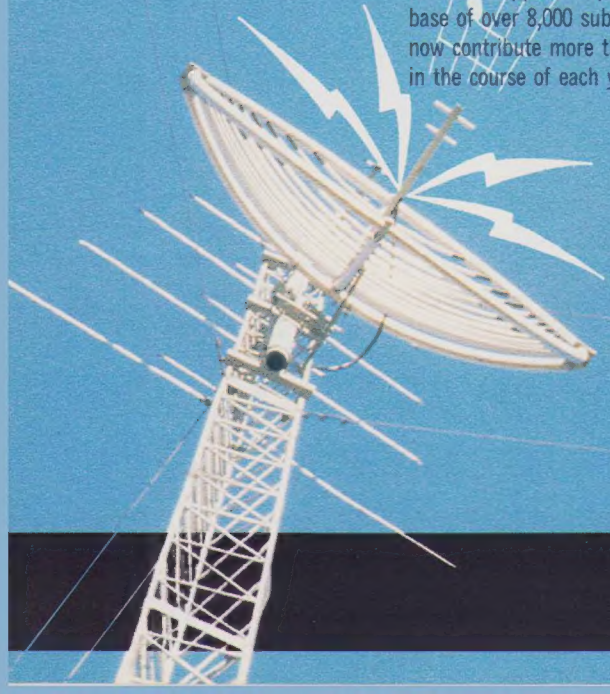
Triple-R is educational, informative, provocative, challenging. Most of all, our listeners tell us that Triple-R is entertaining. Triple-R has never been radio for the background, it is more likely to leap into the foreground and demand attention. Triple-R programs are continually attracting awards from around the world.

The next decade presents new challenges – the changing inner urban and suburban communities, multiculturalism, the altering nature of the workplace, increased leisure time, the 'techno' society, the aging population, the 'clever' country. All these factors facing Triple-R in this next decade ensure that the station will never become a stagnant repository of stale programming ideas. As a vision driven organisation, Triple-R will continue to reach out into its community, to enhance its facilities with new technology and to play an increasingly important role in the developing culture of Australia as we move into the 21st Century.

CORPORATE VISION

TRIPLE-R FM MISSION STATEMENT – 1990

To educate, inform and entertain by drawing upon appropriate community resources to develop a critical approach to contemporary culture.



102.7 FM THREE TRIPLE RRR

21c

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